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Contributions of Dentists Outside the Profession—*Adair*
Bacteriology of Periapical Infection—*Haden*
Pulp Canal Therapeutics—*Puterbaugh*
Functions of Occlusal Surfaces—*Stallard*
Orthodontics and General Dentistry —*Tanzey*
Symposium on Teaching of Oral Hygiene and Periodontia—*Adair, Bryan and Rauh*
Dental Surgery in Cardiovascular Disease—*Barnes*
Unbalanced Adult Occlusion—*Washburn*
Denture Construction—*Horner*
EDITORIALS
The Congress
The Seasons—Autumn
DENTAL HEALTH EDUCATION
Prolonging Life by Dental Prophylaxis —*Spalding*

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CONTENTS

Henry L. Banzhaf, B.Sc., D.D.S., F.A.C.D. ..... Frontispiece

ORIGINAL COMMUNICATIONS

Contributions Dentists Have Made Outside Their Profession.
By Robert B. Adair, D.D.S. 1359

Bacteriology of Chronic Periapical Dental Infection.
By Russell L. Haden, M.D. 1370

Pulp Canal Therapeutics.
By P. G. Puterbaugh, D.D.S., M.D., F.A.C.D. 1384

Functions of the Occlusal Surfaces of the Teeth.
By Harvey Stallard, Ph.B., Ph.D., D.D.S. 1392

Orthodontics and General Dentistry.
By Hugh Grun Tanzey, D.D.S. 1413

Symposium on Teaching of Oral Hygiene and Periodontia—Adair, Bryan and Rauh.

The Teaching of Oral Hygiene and Periodontia to Dental Practitioners.
By Robin Adair, B.S., M.D., D.D.S. 1420

The Teaching of Oral Hygiene and Periodontia in Dental Schools.
By A. W. Bryan, D.D.S. 1424

The Teaching of Oral Hygiene in Schools.
By Sidney J. Rauh, D.D.S. 1430

The Risk of Dental Surgery, Especially in Cases of Cardiovascular Disease.
By Arlie R. Barnes, M.D. 1433

Correction of Unbalanced Adult Occlusion.
By H. B. Washburn, D.D.S. 1441

The Problems of Denture Construction, Including the Conduct of Practice.
By H. J. Horner, D.D.S. 1460

EDITORIAL DEPARTMENT

The Congress 1474

The Seasons—Autumn 1478

Room for All 1481

DEPARTMENT OF DENTAL HEALTH EDUCATION

Can Human Life Be Prolonged by Dental Prophylaxis?
By Grace Rogers Spalding, D.D.S., F.A.A.P. 1482

Preventive Dentistry and Oral Hygiene in Institutional Work.
By Harold DeW. Cross, D.M.D., F.A.C.D. 1489

Diet in Relation to Teeth Development.
By C. K. Johnson, M.D. 1492

Maps 1495

Duties and Conduct of Dental Hygienists in Public Schools.—New List of Educational Material.—Field Notes 1496

NEWS DEPARTMENT

Medical and Dental News 1497

CURRENT LITERATURE

Extracts and Abstracts 1501

ANNOUNCEMENTS

Calendar of Meetings. (National, State, Examining Boards.)—Chicago Dental Society Sixty-Third Annual Meeting and Clinic.—The Union County (N. J.) Dental Society.—Indiana State Board of Dental Examiners.—Kansas State Board of Dental Examiners.—Texas State Board of Dental Examiners.—American Dental Trap Shooters League.—Books Received.—Patents of Interest to Dentists.—The Days That are Drear and Cold 1504-1508

ADVERTISING DEPARTMENT

Index to Advertisements A-77

Classified Section A-70, A-71

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President of the American Dental Association

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Original Communications

CONTRIBUTIONS DENTISTS HAVE MADE OUTSIDE THEIR PROFESSION*

By ROBERT B. ADAIR, D.D.S., Atlanta, Georgia

THROUGH the one hundred and fifty years of our American dental history, the popular opinion of our profession has been that it was narrow and that the average dentist was content to be a fairly good practitioner, lending himself sparingly to movements of civic interest or matters of science or art. But to the student of dental history and biography, such an opinion is indeed false; for no profession has contributed men whose general labors and special accomplishments in the fields of literature, art and science have been more advanced or of greater benefit to humanity than has our own. For many years, this subject has been of deep interest to me and the writings of two men, B. J. Cigrand and Burton Lee Thorpe, have been of special value in the preparation of this paper. Each of these men was a successful practitioner, and each made to literature contributions of historical value. Aside from this, Dr. Thorpe was an organizer of fine ability. In recognition of his efforts in the organization of the St. Louis World's Fair, authorities issued him a commemorative diploma and medal. Dr. Cigrand designed the great seal of the United States and compiled a history of American emblems which is the recognized government authority. Dr. Cigrand held the chair of medical history in the University of Illinois for some time.

Taking these two writers as authority for many facts and dates with

*Read before the Georgia State Dental Society, Savannah, Ga., June 10, 1926.

reference to our pioneer dentists, I shall sketch briefly some of the contributions dentists have made outside their profession.

Ambroise Paré, a Frenchman (1517-1590), whose work in surgery has attracted the world and has been the means of saving many lives, invented the ligature to prevent hemorrhage during surgical work. The swan's-beak forceps for dilating wounds and countless other instruments were of his invention. He was a student of the heavens and made valuable diagrams of the comets of his day.[1]

Two hundred years before our day, Pierre Fauchard (1678-1761), a French dentist, wrote a practical work on dentistry, "Surgeon Dentist or Treatise on the Teeth," which anticipated nearly every phase of our profession that has developed in modern times. He published, in his book, case reports of metastatic diseases, many of which he had discovered had their primary focus in the mouth. The medical profession today in determining the etiology of diseases recognizes metastasis as a most important factor. Another discovery of Fauchard's was the theory of reflex action.[2]

A scientific contribution along another line was that of Dr. John Hunter, a Scotch dentist and surgeon, and general of the British forces in 1790. His deep interest in humanity led him to collect a large and varied assortment of animal specimens, which he presented to the Museum of Royal College of Surgeons of London, and which forms the basis of that Museum. The original value of this collection was $360,000.

1. Cigrand, B. J.: Dent. Rev., 24: 837 (Sept.) 1910.

2. Dent. Cosmos, August, 1923.

To a foreigner, a Frenchman by birth, Joseph Lemayeure, dentistry as a profession in America owes its beginning. He came to this country in 1770 with Count Rochambeau, and became our first dental preceptor. To him belongs the honor of the first successful demonstrations of transplanting and implanting teeth, and out of this has grown the medical process of engrafting and the restoration of facial features and of extremities.[1]

Surpassing all contributions to our profession or any other profession working for the relief of suffering humanity is the gift of Horace Wells in the demonstration of nitrous oxid gas as an anesthetic. Though some claim this honor belongs to Dr. Crawford Long, who was a native of my own state and county, he made no announcement of his discovery until seven years (1849) after he claimed to have first used it, and his own statement was: "I leave it with an enlightened medical profession to say whether or not my claim is forfeited by not being presented earlier." History gives us the following facts and dates which unquestionably give to Horace Wells the honor of the discovery. Dec. 10, 1844, Dr. Wells attended a lecture on chemistry and witnessed the use of laughing gas for the amusement of the audience. Observing that the subjects used in this demonstration were injured yet suffered no pain, Dr. Wells at once consulted with the chemist as to its application to dentistry. He secured a bag of the gas, and the next day administered the gas to himself and had Dr. Riggs extract a tooth for him. The chemist, Professor Colton, states that Dr. Wells and Dr. Riggs continued the successful use of gas. One month after the first demonstration (January, 1845), Dr. Wells

went to Boston to make known and demonstrate his discovery to the medical profession there, but was laughed to scorn by them.

In September, 1846, Boston papers heralded the discovery of anesthesia by Dr. William T. G. Morton, a former student of Dr. Wells, who had witnessed Dr. Wells' use of gas, and Dr. C. T. Jackson, a chemist of Boston. The discovery as claimed by Drs. Morton and Jackson was patented, Nov. 13, 1846, and the medical profession then endorsed its use in general surgery. However, this anesthetic proved to be sulphuric ether, which Dr. Wells had used two years previously but discontinued since it was not so safe as nitrous-oxid gas and not so agreeable to patients. For years, a bitter controversy was waged over the honor of this discovery, but it is now conceded to Horace Wells. Certain memorials to Dr. Wells are of interest to us. In the Army and Navy Museum in Washington, there is a bronze bust presented by the American Dental Association in 1894, the fiftieth anniversary of the discovery. There are two memorials in the city of Hartford; one presented by the Connecticut Dental Association and the other by the general assembly of the state and the city council. The dentists of France have also erected a monument to his memory.[3]

As noted above, John M. Riggs (1811-1885) performed the first operation under any anesthetic when he extracted a tooth for Horace Wells, using nitrous-oxid gas. He is known as the "father of hygienic care of the mouth." Dr. Riggs was an advocate of human rights and human freedom in the widest sense and a vigorous abolitionist. He was foremost in the political movements which led to the formation of the Republican party.[4]

A dentist was the first to administer an anesthetic in an obstetrical case when N. Cooley Keep, of Boston, administered ether to Mrs. Henry W. Longfellow. Dr. Keep was foremost in advocating the formation of the Harvard Dental School, and during the first course of instruction there, he admitted as a student a young colored man, R. T. Freeman, who was among the first to receive a dental directorate degree from the Harvard School.[5]

While the dental profession cannot claim as one of its craft that great surgeon of international fame, Dr. J. Marion Sims, it is a fact that our profession contributed more largely than any other single agent to his success and the enlargement of his usefulness. Our own W. H. Dwinelle, in his private laboratory, gave Dr. Sims a microscopic demonstration which resulted in Dr. Sims' conception of the successful treatment of sterility in women.[6] In an early monograph, Dr. Sims states that it was his friend Dwinelle's enthusiasm which first led him to become acquainted with the wonders and revelations of the microscope. Many of the instruments used by Dr. Sims were the result of Dr. Dwinelle's genius. Dr. Dwinelle told me that he made the instruments used by Dr. Sims for vaginal fistula operations. While Dr. Sims was in France, he had duplicates of some of the Dwinelle in-

3. Thorpe, B. L.: Dent. Brief, 11: 375 (June) 1906.

4. Thorpe, B. L.: Dent. Brief, 10: 164 (March) 1905.

5. Dent. Brief, 24, 1915.

6. Sims, J. Marion: Story of My Life.

struments made, using gold ferrules and pearl handles, and sent them to Dr. Dwinelle as keepsakes.

Another dentist who greatly influenced Dr. Sims' career was Chapin A. Harris, who persuaded Dr. Sims to write for the *American Journal of Dental Science* the history of an operation for harelip that he had performed with the assistance of Dr. Belangee, a dentist of Montgomery, Ala. This article carried with it a picture of Dr. Belangee's dental model, the first ever put into print. At this time, Dr. Sims was 33 years of age, and this was his first written article, for early in life he had conceived the idea that literary work was an impossibility for him. The commendation of medical friends on this first article of Dr. Sims so encouraged him that he afterwards reported his cases for the medical press and greatly broadened his sphere of usefulness.

From our profession have come two peerless men who have devoted their gifts to the relief of special cases of harelip and cleft palate. I speak of Calvin S. Case (1847-1923) and Truman W. Brophy.

Dr. Case's great work was in the direction of the prosthetic correction of cleft palate, where his accomplishments were nothing short of wonderful. After special study of phonetics, he made an obturator which was self-sustaining and which restored the function of the soft palate scientifically, after which he taught the wearer to speak correctly.[7]

Dr. Brophy's renown has come through his unique cleft palate and harelip operation. He learned that if the surgical work in these cases was done in early infancy (from 3 to 6 months), before the nervous system was highly developed, the attending shock was greatly lessened and the result was much more satisfactory. Dr. Brophy also contributed to surgery a peculiar method of operation for ankylosis. I believe that no man in the history of our profession has received more honors at home and abroad than has Dr. Brophy. He has received decorations from practically all the crowned heads of Europe, and last year at the meeting of the International Dental Federation in Geneva (1925), the Miller Medal for dental research was awarded to him.

If, from our profession, it was asked that we name the one man who had, through research and discovery, been a greater blessing than any other, I think we would unhesitatingly say Willoughby D. Miller (Ohio, 1853-1907). Dr. Miller, working under Koch, first segregated a specific germ that would produce dental caries, thus giving to the dental world the theory of germ causation of caries. He is the author of many publications, his best known treatise being "Microorganisms of the Human Mouth." In 1884, the University of Berlin appointed Dr. Miller royal professor, and in 1906, the emperor gave him the title of medical privy councellor. Neither honor had ever before been conferred on an American, the latter having never been conferred on a dentist of any nationality.[8]

Another dentist who is known, loved and honored in other lands besides our own is G. V. Black, the "father of scientific dentistry," William A. Evans, M.D., Chicago, some years ago, in speaking of Dr. Black

7. Footnote 5; Dent. Cosmos, June, 1923.

8. Dent. Summary, 27: 666, 1907.

said: "He has been a dreamer, a student, a research man, a deviser of instruments, a designer of methods and an artist, and his writings which set forth dental research and advances of medicine and the sciences have gone to every part of the world and left the imprint of his genius upon every scientific page that has been written during the last quarter of a century." Dr. Black's pen and ink sketches and water color work are excellent. The only complete set of life sized water color illustrations on dental fractures was made by Dr. Black for a friend, Dr. T. L. Gilmer.

Speaking of the art work of Dr. Black reminds me of the ranking artist in our craft, Norman Kingsley, of New York, the "father of modern oral surgery," and the inventor of the blowpipe. Dr. Kingsley's pyrographic copies of some of the old masterpieces are most creditable, but his best work is in bronze and marble, the two choicest pieces being a bronze bust of Whitelaw Reid, now in the Lotus Club, New York City, and a head of Christ, chiseled in 1868 and now in the Evans Museum in Philadelphia.[5]

Dr. J. B. Newbrough of New York distinguished himself by his remarkable oil paintings for the New Oahspe Bible. It is claimed that his work was done under a psychic spell and that in painting he used both hands at the same time.

The dentists who first published to the profession the use of arsenic for devitalizing dental pulp was a man of artistic and literary ability worthy of special mention, Shearjasbub Spooner of Vermont (1809-1859). He published a beautifully illustrated edition of the New Testament, the American edition of Boydell's "Illustration of Themes of Shakespeare and Biographical and Critical Dictionary of Painters, Engravers, Sculptors, Architects and Curiosities of Art."

Dr. Charles Wilson Peale (Maryland, 1741) was the first to paint a picture of George Washington. He painted eight portraits of Washington, and also portraits of LaFayette, Randolph, Charles Thompson, William Pitt and Francis Key. Dr. Peale was the founder of the Philadelphia Academy of Fine Arts. He took up dentistry after years of work in art and brought to his dental work all the knowledge of form, color and shade which made it possible for him to give us the beauty and variety of tooth form and shape in our present porcelain substitutes. It was Dr. Peale who discovered the mastodon in Virginia and expended thousands of dollars to deliver it in Philadelphia, where it constituted the beginning of a great natural history museum, containing hundreds of specimens.

Dr. James Baxter Bean of Georgia rendered valuable service in the hospitals in Atlanta during the Civil War. Dr. Bean was a great natural scientist. He lost his life in a scientific adventure, taking observations in the interests of the Smithsonian Institute of Washington, D. C., while ascending Mont Blanc, Switzerland. While his feet were frozen and death was stealing up his extremities toward his heart, he kept his pencil going at a rapid rate, recording his sensations on a tablet as he gradually froze to death. He died in the interest of science and left his life's work unfinished.[9]

T. S. Hitchcock, of Seneca Falls, a dentist whose hobby was the collection of

9. Koch: History of Dental Surgery.

flora and petrified woods, has received government recognition for special work along this line. He has also a museum of guns, pistols, armor, swords and powder guns, which has interested historians, and his collection of cameos is perhaps the largest in the world.

The accompliments of J. J. R. Patrick, of Illinois, along scientific lines are most noteworthy, since he has achieved distinction as an anthropologist, ethnologist, archeologist, geologist and comparative anatomist. In the Smithsonian Institute are to be found his maps of the Cahokia mounds. These maps and his Indian relics are considered among the most important in the possession of our Government. Dr. Patrick's historical collections now belong to the Missouri State Historical Society. Years ago, I visited him and had the pleasure of seeing his collection of Indian relics and his magnificent library.

We have now in our ranks a dentist who has given much time to the study of entomology, Dr. R. Ottolengui of New York. He has accumulated a splendid collection of butterflies and moths and is an authority along this line. He has become nationally known for his demonstration of identification of bodies by teeth even after cremation. Dr. Ottolengui's success in the literary realm has perhaps brought him the greatest prominence, for he has written many short stories and books. His best known works are the "Crime of the Century," "The Conflict of Evidence," "A Modern Wizard" and "An Artist in Crime." The latter has had German and French translations.[5]

Dr. J. Leon Williams of London, a dentist, is also a man of artistic and literary attainments. "Home and Haunts of Shakespeare," "Studies of Irving's Sleepy Hollow" and "Sicily, Land of Departed Gods" are his choicest literary productions. His work in photography also deserves special mention.[1]

About thirty years ago, while on a trip to New York, I met a dentist of whom little is known, yet one whose work should be of interest to us, Dr. J. J. Main. He was quite an old man when I met him. I found him to be a great student, a man of broad culture and one who, through business relationships with J. J. Gould, had amassed great wealth. His hobby was the study of minerals, and it was he who first developed the coal industry in Illinois near Rock Island. He sold his interests to the Rock Island Railroad. A sailor, who was one day a patient of his, told him of an island off the coast of Peru that, through the ages, had been built up by the droppings of sea fowls. Main's interest was at once awakened. He made the trip to Peru, had the soil of certain islands off the coast analyzed and, finding it to be rich in properties necessary to the growth of corn and cotton, purchased several islands and shortly placed on the American market what is known as Peruvian guano.

One of our most scholarly dentists of the early days, Dr. H. H. Hayden, was also a mineralogist. A mineral which he discovered was called "haydenite." Dr. Hayden wrote the first general work on geology, which was published in 1821. It was Hayden who first convinced the medical profession of the necessity of oral hygiene, and he was the first of our profession to lecture in a medical college (1769-1844).

Closely associated with Dr. Hayden was Chapin A. Harris (1806-1860), who gave us a book that is perhaps the most popular dental work ever written

"Principles and Practice of Dental Surgery," also a dental dictionary. Traceable to his energy and foresightedness are our first dental journal, the first dental society and the first dental college in the world (1840). I have purposely mentioned the dental contributions of these two men and shall mention several others who, through contributions to dental literature, the establishment of dental schools and affiliation with the medical profession, have rendered service which far outreaches the bounds of our profession. Dr. Guerni (Italy, 1859) wrote a "History of Ancient Dentistry," which was the first comprehensive history of our profession. In 1894, he took a prominent part in the International Medical Congress in Rome, exhibiting there reproductions of all archaeological dental appliances existing in Italian museums, which had been made by him at the request of the Italian Public Health Department.[1]

Dr. W. H. Atkinson (1815-1891), to whom we are indebted for an improved professional nomenclature and for the open clinic, through his research work made contributions of general scientific value. His best known writings are "History and Microscopy." "Necrosis," "Inflammation," and "Origin of Pus." The establishment of a school of microscopy in New York, under the management of Carl Heitzman, was due to Dr. Atkinson's persistent energy and perseverance.

A dentist who twice held the vice presidency of the American Medical Association and whose dominating desire was to strengthen the bonds between the medical and dental professions was Eugene S. Talbot of Illinois (1847-1924). To Dr. Talbot's able direction was due the establishment of the section on stomatology of the American Medical Association, in 1881, and the conveying to members of the medical profession, through their own journal, the truths of the general pathologic importance of oral diseases, now so generally understood. Dr. Talbot's contributions to medical and dental literature were very extensive. His book "Degeneracy, Its Causes, Signs and Results" is a standard reference work.[10]

The formation of a complete dental section in the International Medical Congress (Washington, 1887, 9th session) was due to the influence of Walter Webb Allport (1824-1893). In this section, all branches of dentistry were for the first time represented, and it was my privilege to be the clinician on pyorrhea. Dr. Allport firmly held that dentistry was a specialty of medicine and he was instrumental in establishing a chair of dental and oral surgery in seven medical schools. [11]

The first member of our profession to leave a large bequest for dental education was Thomas W. Evans, who gave about one and a half million dollars for the establishment and maintenance of a dental school in Philadelphia. This fund was diverted to a dental building in connection with the University of Pennsylvania and to its endowment. Dr. Evans' library and museum are housed in the building known as the Thomas W. Evans Museum and Dental Institute, School of Dentistry, University of Pennsylvania.

It was in Paris that Dr. Evans amassed the fortune which enabled him to provide this magnificent monument to his name. His confidental relationship with Napoleon III has become

10. Dent. Cosmos, February, 1925.

11. Dent. Brief, 11, 1906.

historical, and its two most important results, namely, the diplomatic mission entrusted to him by Napoleon to President Lincoln during the War of the Rebellion, which resulted in the neutrality of France with respect to the issue, and the aid rendered by him to the Empress Eugenie in her escape to England during the riots following the fall of Sedan at the close of the Franco-Pressian war are matters of common knowledge. When an emergency tracheotomy operation for Emperor Frederick of Germany became necessary, Dr. Evans' ingenuity in devising a silver tube for insertion in the trachea was the means of saving the emperor's life.

Much of Dr. Evans' life was devoted to works of charity and philanthropy. He rendered important service during the Crimean and Franco-Prussian wars in the care of wounded soldiers and in introducing more sanitary and humane methods in military hospitals. Dr. Evans used all his influence toward the elevation of the general status of his profession, and he lived to see his chosen calling placed upon more commanding ground, and the value of its ministrations to his generation substantially recognized. That his life work was a large contributing factor to that end cannot be doubted, and when all of the factors which have helped in the advancement of the professional status of dentistry are fairly estimated, the influence of the life of Thomas W. Evans will be among the greatest. His memoirs, edited by Dr. E. A. Crane under the title of "The Second French Empire," are interesting to even a casual reader, but especially so to members of our profession.[7]

The story of Paul Revere is familiar to every child in our land, and yet few people know that he was a practicing prosthetic dentist at the time he came into Revolutionary fame by his midnight ride, which not only aroused citizens to the movements of the British and to the protection of arms and ammunition stored at Lexington, but also saved the lives of Adams and Hancock. Revere was an expert at founding bells and an engraver of colonial fame. His original sketch of the Boston massacre was the foundation for later paintings of the massacre which are familiar to us and are so often seen in patriotic halls.

The first man to take a deep interest in prison reform was Dr. Eleazer Parmley (1797). The first meeting of the Prison Association of New York took place in the home of Dr. Parmley and was endorsed by President Lincoln.[1]

One of our pioneer oral surgeons and philanthropists, Dr. Simon P. Hullihen (Pennsylvania, 1810-1857), founded a great general hospital in Wheeling, W. Va. (1850). The citizens of Wheeling, as a tribute to the life and work of Dr. Hullihen, have erected a beautiful marble shaft to his memory. Dr. Hullihen was a close student and one of the most ingenious oral surgeons of his day. He made valuable contributions to dental literature.[12]

As far as I can discover there have been only four dentists who have served as members of Congress: Henrik Shipstead, Minnesota, U. S. Senate, 1923-1929; Frank Crowther, New Jersey, member of the 66th, 67th and 68th Congresses; J. S. Wolff, Missouri, member of the 68th Congress, and

12. Thorpe, B. L. Dent. Rev., 17: 250 (March) 1903.

R. O. Woodruff, Michigan, member of the 63rd, 68th and 69th Congresses.

Because inventive genius is such a marked characteristic of dentists, we have had a fine group of general practitioners who have invented articles of great commercial value. Among the number was one who invented our rotary churn. This was Amos Westcott (New York, 1815), the father of the author of "David Harum."

To Dr. S. A. White of Savannah, Ga., should go the credit for the invention of the rotary fan. One oppressively hot summer day, Dr. White closed his office, resolving to escape from the heat at an ocean resort. As he drove along he noticed an old fashioned windmill twirling lazily in the slight breeze. Since his mind was already occupied with thoughts of the heat and means of escape therefrom, the sight of the windmill put in motion a train of thought which evolved the idea of the rotary fan. Dr. White immediately returned to his office and constructed the first crude rotary fan. It was made with four large palmetto fans stuck in a cylindrical holder. The holder, placed on an axle, was connected by a belt with a small water motor. This device was placed over Dr. White's operating chair, and crude though it was, enabled the doctor and his patients to enjoy cooling breezes during the summer months.

Listed to the credit of W. E. Harper of Chicago are the following inventions: Harper sample holder for sampling silks and dress goods, the universal trimmer and the Harper wire and stitching machine for binding books. Dr. Harper has made many models and inventions of a dental nature, one set of his models having been adopted in teaching the art of dentistry. This is a set of large tooth models, 3 feet high, used in teaching dental anatomy, cavity preparation and instrumentation.

Dr. T. B. Welch introduced the refreshing prohibition beverage of grape juice. He also introduced a system of phonetic spelling.

Dr. John Greenwood invented the fife, which contributed much toward keeping up the spirits of soldiers during the Revolution. He was made fife major at Bunker Hill.

Several years before the Civil War, a dentist, Dr. Edward Maynard of New York (1813-1891), patented the first breech loading rifle. This model revolutionized the arms of the civilized world. Many other patents in fire arms and ammunition were also granted to Dr. Maynard. All of his models, his inventions in guns, his medals and decorations are deposited in the National Museum in Washington in cases set apart for them for the purpose of showing everything in the line of firearms from his earliest to his latest invention. Maynard practiced in Washington, and his inventions were only a side line. He performed special operations abroad, was associate editor of the *American Journal Dental Science* and held the chair of theory and practice of dentistry in Baltimore College and in Washington National University.[11]

Dr. B. B. Alfred (Connecticut, 1817-1880), who located in Georgia in 1855, rendered valuable assistance to the women of the south during the Civil War by making needles for them during the blockade.[9]

When the great Washington monument was reared and the designers and founders could discover no way to tip the shaft with metal, a dentist, Dr. C. C. Carroll, who had discovered

a process for casting aluminum, cast the tip for this monumental shaft.

Among contributions toward the world's commercial advancement must be classed the work of William G. A. Bonwill. The present riveting mallet which ties and binds steel girders and metal braces is a direct copy of the Bonwill instruments. Dr. Bonwill also contributed toward the perfecting of the self-binder used in wheat fields.[7]

Dr. Roberts, of Titusville, Pa., invented the drill which made possible oil well shooting.

In recent correspondence with Dr. C. Edmund Kells, I learned that he was the inventor of the first automatic fire alarm that was of any value. This type of alarm was adopted by the government. He has government patents (1880-1922) on thirty of his inventions, ranging from bottle stoppers and stills to automobile engine starters and electrical signaling apparatus. Dr. Kells was the first man to use street electric current in operating dental equipment.

Dr. Jesse Cope Green, of Westchester, Pa., for sixty-five years kept accurate and uninterrupted weather records in his locality, and his records, antedating those of the Government, are copied in the archives of the Signal Service and Navy Bureau. A communication from our Government Weather Bureau tells me that this personal record of Dr. Green's is the longest ever kept by any individual in this country, if not in the world. Several years ago, the Weather Bureau made every possible effort to have the complete records of Dr. Green published in pamphlet form, but the principles of economy being fostered by the Government would not permit of that expense. Dr. Green was a skilled technician, having made anemometers and raingages of his own design for his weather observations. He also found time to construct several fine microscopes, and tradition has it that no better trout rod has ever been constructed than that made by Dr. Green.[13]

For the invention of a system of wireless telegraphy and radio the world has, since 1900, given all credit to Marconi (Italy, 1874), who invented a system and established public service in wireless and radio, which has been developed through the years by his company. July 30, 1872, two years before Marconi was born, a dentist of Washington, D. C., was granted a patent on a wireless telegraph invention which he had successfully demonstrated, the principles of which were basic and scientifically correct and should have given to him the honor of discovery and to America the distinction of presenting wireless telegraphy to the world. The dentist was Mahlon Loomis (1826-1886), and his story is most interesting. He was born in Oppenheim, N. Y., in 1826, and practiced dentistry in Earlville, N. Y., Cambridge, Mass., Philadelphia and Washington. The first public demonstration of what he called his system of "aerial telegraphy" was made in 1866 from two peaks of the Blue Ridge Mountains in Virginia, about 18 miles apart. From each peak, an ordinary kite was elevated, connected with an insulated copper wire attached at the lower end to a telegraphing apparatus. The operators of each party were provided with telescopes with which they could watch from one station to another and read the signals. When all was in readiness, a message

13. Editorial, Dent. Cosmos, 60: 163 (Feb.) 1918, U. S. Dept. Agriculture, Weather Bureau Rep.

was sent by Dr. Green along the wire of his kite and was received at the station on the other mountain top just as though the two kites had been connected with a wire in the ordinary way. Communications were kept up until the fact was thoroughly demonstrated that telegraphing could be done as readily without as with connecting wires.

Shortly thereafter, Dr. Loomis made a successful experiment in communication between vessels stationed 2 miles apart in Chesapeake Bay. Dr. Loomis, being unable to finance his invention, prevailed on Boston capitalists to advance the necessary money to establish it on a commercial basis, when came "Black Friday in Wall Street," and these capitalists lost all they possessed. Dr. Loomis then went to Chicago, where moneyed men agreed to finance him, but ill-luck again followed, for the great Chicago fire came just at this time and the men who were to back him were reduced to poverty. Constant appeals were made to Congress from 1869 to 1873 for assistance in making it possible for America to establish telegraphy without wires. In 1873 Congress passed a bill incorporating the "Loomis Aerial Telegraph Co.," which was signed by President Grant. Congress, however, overlooked the appropriation of $50,000 asked for, and, naturally the company never functioned. H. O. Bishop, in an article in the Dearborn *Independent* said, "Had it not been for the attitude of big newspapers and the stubbornness and lack of vision of Congress, this country today would be enjoying the honor of presenting wireless telegraphy to the world. A. T. Story, English author, in his "Story of Wireless Telegraphy" concedes that Dr. Mahlon Loomis is credited as being the first experimenter to conceive the idea of utilizing the electricity existing in the atmosphere for the purpose of establishing electrical communication between distant places. Robert H. Marriott, the first president of the Institute of Radio Engineers, writing in *Radio Broadcast*, December, 1925, an outline history of radio, gives these facts:

> Dr. Salva wrote a recipe for wireless in 1795 and his scheme, had it worked, would have been wireless but not radio; Morse built a wireless which worked across narrow bodies of water, in 1842, but this was not a radio; Maxwell wrote a theory for radio in 1867 but this was not worked out until 1886 by Hertz; Loomis patented a wireless in 1872 and his patent was not only for communicating without wires but for taking the electricity to do it with, from the atmosphere. The idea of Loomis' patent worked according to radio theory. He wanted to make static send messages. In 1879 Hughes made and used a radio but only let a few friends in on it; Dolbear patented on in 1886; Hertz then made his radio system in 1886 and that led others into the radio of today.

This outline clearly shows that Dr. Loomis was the first to patent a wireless with radio theory.[14]

The foregoing are only a few of the accomplishments of our profession, but I am sure they are sufficient to prove that it is and always has been, a potent factor in the history of the world.

14. Editorial, Dent. Summary, 41: 169 (Feb.) 1921.

BACTERIOLOGY OF CHRONIC PERIAPICAL DENTAL INFECTION*

By RUSSELL L. HADEN, M.D., Kansas City, Missouri

IN determining the relation of dental disease to systemic disorders, it is most important to know the bacteriologic status of the periapical tissues of those teeth in which the pulp is dead or dying. An area of dental infection can be a factor in systemic disease only by reason of the presence therein of bacteria. The clinician should know the frequency of periapical infection, the types of bacteria present and the pathogenicity of the organisms. Likewise, the dentist needs such data in deciding on methods of treatment.

Unfortunately, the exact bacteriologic status of any one given tooth can be obtained only by making cultures after the removal of tissues in which infection is suspected. We should like most of all to know how dependable are the methods of diagnosis which can be applied before operation. This is especially true of the dental radiogram, which is largely depended on to detect periapical infection. Certain anatomic changes observed in the radiogram are commonly accepted as indicative of infection.

The important criteria are absorption or condensation of bone, deviation from the normal in the peridental membrane, and lamella and absorption of the root tip. One wishes to know whether bacteria can be present around the apices of pulpless teeth which show no changes in the radiogram, and likewise whether pulpless teeth which show changes usually taken as diagnostic of infection always show bacteria when cultured. The answer to these questions will determine how far the radiogram can be relied on in determining the presence or absence of periapical disease. I have cultured the periapical tissue of a large number of teeth with the hope that the results might allow certain generalizations in determining the best method of treatment in a given case.

The bacteriology of chronic periapical infection has been little studied by cultural methods. Most observers report only a small series of cultures. Usually, liquid culture mediums alone, which give no idea of the number of bacteria present in the material cultured, have been employed. Miller,[1] in his classic studies on dental bacteriology, gave scant attention to chronic periapical infection. Moody,[2] in fifty-five chronic alveolar infections, found *Streptococcus viridans* the predominant organism.

*Read at the Midwinter Clinic of the Chicago Dental Society, Jan. 27, 1926.

*From the Department of Medical Research, Deaner Institute, Kansas City, Mo.

1. Miller, W. D.: Die Mikroorganismen der Mundhohle, Leipzig, 1892.

2. Moody, A. M.: J. Infect. Dis., 19: 515, 1916.

Hartzell and Henrici[3] cultured 282 cases of chronic alveolar infections and found streptococci, either pure or contaminated with *Staphylococcus albus*. Lucas[4] made 181 cultures, of which 155 were positive. A variety of organisms were obtained, the streptococcus being predominant. Smith,[5] in dental infections in children, found streptococci of all types, the pneumococcus and the staphylococcus. Rickert,[6] using dextrose brain broth, made cultures from the apex of more than 200 pulpless teeth and found 51 per cent positive and 49 per cent negative. The cultures were made from curettings of the exposed apex before extraction. No one of the workers quoted has attempted a quantitative study of periapical infection.

MEDIUMS AND TECHNIC

Mediums used in culturing periapical tissues must meet certain requirements. The bacteria in chronic foci are usually only relatively virulent, and often become adapted to certain living conditions which determine both growth and disease-producing power. Suitable conditions for the growth of organisms commonly found must be provided. The most important factor, perhaps, is the oxygen tension, as repeatedly emphasized by Rosenow. The method of culture should also afford a means of determining the number of viable organisms present. This is especially important in cultures from dental foci, since it is quite difficult to extract teeth without occasionally picking up organisms from the saliva. In culturing the material in broth only, a culture tube in which one chance contaminating organism is present may be no different after twenty-four hours incubation from the tube inoculated with the many organisms contained in an area of actual periapical infection. It is often desirable to inoculate animals with the organism grown to determine its virulence or elective localizing power. The inoculation must be made with freshly isolated cultures. A liquid culture medium is necessary for this purpose.

To meet the various cultural requirements, I have cultured all tissues in deep tubes of glucose brain broth agar and glucose brain broth. These mediums afford all gradations of oxygen tension. The hydrogen ion concentration is approximately 7.0. The nutritive qualities are especially favorable for the growth of the organisms in infections about the teeth. The agar medium shows also the number of bacteria in the material inoculated which can be grown. Only sufficient agar is added barely to solidify. This does not retard growth, yet holds the colonies discrete. The broth medium is used for the inoculation of animals; for transplants to blood agar plates, and for identification of the organisms present by the gram stain.

The mediums used have been prepared as follows:

Glucose brain broth: Dehydrated bactonutrient broth, 8 gm.; sodium chlorid 8 gm.; dextrose, chemically pure, 2 gm.; Andrade indicator, 10 c.c., and distilled water, 1,000 c.c.

3. Hartzell, T. B.; Henrici, A. T., Leonard, H. J.: Report of the Minnesota Division of the Scientific Foundation and Research Commission, J.N.D.A., 2: 333 (Nov.) 1915.

4. Lucas, C. D.: Dent. Cosmos, 62: 1197 (Oct.) 1920.

5. Smith, A. L.: Arch Pediat. 36: 148 (March) 1919.

6. Rickert, U. G.: Report of Research Committee Financed by the Michigan State Dental Society, J.N.D.A., 9: 300 (April) 1922.

The broth and salt are dissolved by heating. After cooling, the indicator and dextrose are added. The medium is tubed in 6 by ¾ inch test tubes so that the depth is at least 3½ or 4 inches. Three pieces of calf brain, about 1 c.mm. square, and two or three pieces of crushed marble are added to each tube. The tubes are then sterilized for twenty minutes in the autoclave at 20 pounds (9.07 kg.) pressure.

Glucose brain agar: Powdered agar 7 gm. added to 1 liter of the glucose brain broth prepared as indicated above. The calf brain and marble are then added, and the medium is sterilized.

Carbohydrate broth: (We have found it difficult to grow many of the strains of streptococci in the broth prepared according to Holman's[7] directions, so a modified brain broth has been employed.) Lactose, mannite, and salicin added to sugar-free broth in the proportion of 1 per cent. Small pieces of calf brain were placed in ½ by 4 inch test tubes and the broth added. All strains grew well in this medium.

Blood agar: Approximately 5 c.c. of citrated human bood added to 100 c.c. of 1.5 per cent nutrient agar.

Great care has been used in obtaining the culture material in such a manner as to avoid contamination. The field of operation is prepared by first scrubbing well with gauze the teeth to be extracted. The teeth and gums are then painted with iodin. Care is taken that the iodin penetrate well into the space between the gum margin and teeth and between the adjacent teeth. The iodin is removed with alcohol, and the area of operation walled off with sterile gauze. The tooth is extracted with sterile forceps. After extraction, the apex of the tooth is cut off with a sterile instrument directly into a tube containing about 1 c.c. of sterile 0.85 per cent sodium chlorid and a small amount of sharp sand.

In making the culture, the tube containing the root tip is well shaken, to macerate the tissue on the tip of the tooth. The culture material is then poured into a deep tube of glucose brain agar which has been heated and cooled to 40 C. The tube is quickly inverted once and allowed to harden. The small amount of salt solution remaining in the tube is poured into a tube of glucose brain broth. The inoculated tubes are incubated at 38 C. for from twenty-four to forty-eight hours. Usually, the maximum growth takes place in twenty-four hours.

After incubation, the colonies present in the agar shake tube are counted up to 100. An accurate count is not attempted in tubes showing more than 100. Enormous numbers of colonies are commonly present in the positive cultures.

Gram stains were routinely made of the positive broth cultures.

For determination of type, transplants were made from the broth tubes to blood agar plates. Single colonies of streptococci were picked from the agar plates and transferred to a tube of brain broth, and incubated. From this tube, transplants were made to the carbohydrate broth tubes.

CLINICAL MATERIAL

Apical cultures have been made from more than 3,000 teeth. For statistical purposes, I have included here the cultures from incisors, cuspids and bicuspids only. The molars are excluded on account of the much greater chance of contamination, though we have found that vital molars may be ex-

7. Holman, W. L.: J. Med. Res., 34: 377, 1916.

tracted without contamination, in a large percentage of cases. A notation has been made on a chart kept for each case concerning the possibility of contamination in the extraction. In compiling the statistics, only clean extractions are included.

Controls are necessary to determine the chances of error. The best controls are obviously cultures of vital teeth employing the same technic as in culturing the pulpless teeth. I have constantly cultured vital teeth for this check, thus affording a base line for the interpretation of results obtained in pulpless teeth. The cultures have been quite evenly divided between vital, radiographically negative pulpless and radiographically positive pulpless teeth.

It is apparent that the results of cultures of dental foci will vary with the class of patients from whom the material is drawn. The much higher incidence of apical infection in hospital patients than in patients presenting no evidence of systemic disease has been emphasized. Likewise, among hospital patients, a larger percentage of those having disease of focal origin, such as arthritis, will have apical abscesses than will those having other types of disease, such as pneumonia. Our material was drawn from patients entering a pay dental clinic. These were largely ambulant patients, who came primarily for dental treatment. Some were under medical treatment in a hospital for systemic disease. Others, while ambulant, were referred by physicians for the removal of dental foci which were considered related etiologically to systemic disease. The incidence of pulpless teeth as observed in this clinic has been reported elsewhere.[8] Of 500 unselected patients, 91 per cent had one or more pulpless teeth. The average number of pulpless teeth per mouth was 3.4.

The radiograms have been made by a uniform method of exposure and development, giving constant results. At least fourteen films were taken for each patient, affording at least two views of each tooth.

I have divided the teeth cultured into three groups: (1) vital, (2) pulpless and negative in the radiogram, and (3) pulpless and positive in the radiogram. This classification is obviously open to criticism. All classifications are unsatisfactory. The "vitality" of the pulp is a relative matter. A pulp may be vital though diseased, and responsive to thermal and electric stimuli. I have classified as vital those teeth which respond to the electric current. In such teeth, the pulp functions, though perhaps not normally. Teeth which show no response to stimuli have been classified as pulpless. These are certainly pulpless from the standpoint of function, regardless of whether the pulp is still in position though dead, or has been mechanically removed.

There is necessarily much difference of opinion concerning just what should be called positive radiographic criteria of infection. There is no common agreement as to exactly what teeth should be placed in the radiographic group. I have taken a conservative attitude.

RESULTS OF QUANTITATIVE CULTURES

Fifteen hundred cultures of incisor, cuspid and bicuspid teeth have been made from February, 1922, to March,

8. Haden, R. L.: Incidence of Pulpless Teeth, J.A.D.A., 11: 730 (Aug.) 1924.

1925. These include all anterior teeth satisfactorily cultured during this period. The total cultures, including molar teeth, number more than 3,000. This report covers only the study of cultures from anterior teeth. The results of the cultures are shown in Table 1.

Four hundred cultures were made from vital teeth. It is assumed that vital teeth without caries are sterile. Positive cultures in this group are taken as indicating only the chances of technical error. Eighty-five and five-tenths per cent showed no growth in the agar tube, and 45 per cent were sterile in the broth culture. A positive culture in broth with no growth in agar indicates, probably, that only a few organisms were present in the material cultured, picked up possibly in the process of extraction. The high percentage of positive broth cultures from vital teeth emphasizes the futility of using broth only as a routine culture medium. It is apparent that positive cultures from pulpless teeth mean little when such a high percentage of positive cultures are obtained from vital teeth. Of the 14.5 per cent of positive cultures in agar, 9.8 per cent contained less than ten colonies per tube. Only 1.2 per cent contained less than ten colonies per tube. Only 1.2 per cent of the total contained as many as 100 colonies per tube, and 4.8 per cent of the 400 cultures showed ten or more colonies per tube.

TABLE 1.—RESULTS OF APICAL CULTURES FROM 1,500 TEETH.

Group	Total Number	Number of Colonies in Deep Agar Tube							Broth	
		0	0-10	10-50	50-100	Over 100	1 or More	10 or More	Positive	Negative
Vital	400	Per cent 85.5	Per cent 9.8	Per cent 2.8	Per cent 0.8	Per cent 1.2	Per cent 14.5	Per cent 4.8	Per cent 55.0	Per cent 45.0
Pulpless teeth with negative radiogram	600	44.3	9.5	16.7	4.0	25.7	56.7	46.2	83.8	16.8
Pulpless teeth with positive radiograms	500	26.6	10.6	11.4	4.2	44.2	73.4	62.8	91.0	9.0
All pulpless	1,100	36.3	10.0	14.3	4.0	34.1	64.6	53.7	87.1	12.9

A bacteriologic study in which contamination can never be absolutely ruled out is necessarily only a relative one. The results of cultures of pulpless teeth are of value only in comparison with the result of cultures of vital teeth. As the best basis for comparison, we have arbitrarily selected the groups of positive cultures in which the agar tube contained ten or more colonies. The results of the cultures from vital teeth indicate that such contaminating organ-

isms as were found were usually less than ten per tube.

It should be emphasized that the positive cultures in the vital group are taken only as a measure of the technical errors incident to this study. A positive culture is not synonymous with infection. In the presence of caries, the pulp may be infected though vital. I have found not infrequently that an apical culture from a carious tooth which still responds to vitality tests may show large numbers of bacteria. Some of the positive cultures in the vital group may thus represent actual infection. The number of these cannot be determined; hence, for our present purposes, we have counted such positive cultures as are representing technical errors. The positive cultures thus indicate the maximum chances of error in technic. The sole purpose of this control group is to furnish such data.

Of 500 radiographically positive pulpless teeth cultured, 26.6 per cent showed no colonies in the agar shake tube; 44.2 per cent had more than 100 colonies; 73.4 per cent had one or more colonies, and 62.8 per cent had ten or more colonies. A high percentage of the positive agar cultures showed a large number of organisms.

Nine per cent of the radiographically positive group were negative in broth. These were, of course, also negative in agar. Some observers believe that, once a tooth is infected, it is always infected. It is most probable that such structural changes as were evidenced in the radiograms indicate definitely the earlier presence and activity of bacteria. The finding of a negative culture is the best evidence that the areas were bacteria-free at the time the cultures were made. Such teeth evidently can be of no importance in the causation of systemic disease. The number of sterile radiographically positive teeth is so small that their occasional occurrence is no valid excuse for allowing radiographically positive teeth to remain untreated.

The pulpless teeth with negative radiograms constitute the most important group. There is little argument concerning the disposition of radiographically positive teeth. There is the greatest difference of opinion concerning what disposition should be made of teeth that are negative in the radiogram. Discussion concerning the possible relation of such teeth to systemic disease should be based on knowledge concerning the bacteriologic status, not upon structural changes. The structural changes which we take as indicating infection are, in large part, evidence only of resistance, that an inciting agent is present. The radiographically negative teeth are only those which show no evidence of resistance. This does not necessarily mean that no bacteria are present. It seems most probable that pulpless teeth that show no evidence or resistance and yet harbor bacteria are more apt to cause systemic disease, since there is no barrier to the entrance of bacteria and their products into the blood and lymph channels.

Of 600 pulpless teeth with negative radiograms cultured, 44.3 per cent showed no organisms in the agar shake tube; 25.7 per cent had more than 100 colonies, and 56.7 per cent, one or more colonies. The comparative group containing ten colonies per tube constitute 46.2 per cent of the total number, of which 16.8 per cent were sterile in broth.

The most noteworthy finding in the

roentgen-ray negative group is the high percentage showing bacteriologic evidence of infection without radiographic evidence. The incidence of infection is nearly as high as in the radiographically positive group. Considering all pulpless teeth together, 36.3 per cent showed no colonies in the agar tube; 34.1 per cent had more than 100 colonies; 64.6 per cent, one or more colonies; 53.7 per cent, ten or more colonies, and 12.9 per cent were sterile in broth.

Table 2.—Comparison of Results of Cultures From Radiographically Negative Teeth for Different Intervals.

Date	Total Number	Number of Colonies in Deep Agar Tube							Broth	
		0	0-10	10-50	50-100	Over 100	1 or more	10 or more	Positive	Negative
		Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
July 1, 1923	254	29.6	9.8	9.8	5.1	45.7	70.4	60.6	90.9	9.1
Sept. 25, 1923	278	28.8	9.0	11.5	5.4	45.0	71.2	61.1	91.6	8.6
May 1, 1924	339	28.6	9.0	9.0	5.3	43.6	71.4	61.7	90.9	9.1
Oct. 24, 1924	425	26.6	10.4	11.3	4.7	43.5	73.4	63.0	91.6	9.4
March 11, 1925	500	26.6	10.6	11.4	4.2	44.2	73.4	62.8	91.0	9.0

Comparison of Quantitative Cultures Over Different Periods

The cultures included in this report have been made over a period of three years. The total cultures have been summarized five different times. The percentages have varied little. The results of the cultures of the roentgen-ray positive group for the different periods are shown in Table 2. For the first 254 cultures, 60.6 per cent showed ten or more colonies; while for the total 500, the percentage is 62.8. The other figures correspond equally closely. This striking constancy indicates that our results really represent what was present by the technic employed.

Types of Organisms

A smear was routinely made from the broth culture and gram stained. In the 1,091 positive broth cultures, a gram-negative bacillus was found once. In 963 cultures, streptococci only were found. In nine cultures, streptococci were mixed with staphylococci, and in thirty-seven, with gram-positive bacilli. Streptococci were present alone or mixed with other organisms in 1,009 or 92.5 per cent of the 1,091 positive cultures. Gram-positive bacilli only were found fifty-eight times; a staphylococcus, only nineteen times, and the two together, three times.

Some of the stains of streptococci grew in long chains. The most com-

mon type is a diplococcus, which is usually elongate, often lanceolate, and thus closely resembles the pneumococcus. The morphologic appearance varies greatly with the culture medium. An organism appearing in diplococcus form in broth may show very long chains in agar.

The types of organisms found in the various groups are given in Table 3.

TABLE 3.—ORGANISMS FOUND IN APICAL CULTURES AS IDENTIFIED BY GRAM STAIN OF BROTH CULTURE.

Organism	Vital	Pulpless Radiographically Negative	Pulpless Radiographically Positive	Total
Streptococcus only	157	416	390	963
Staphylococcus only	13	4	2	19
Staphylococcus and streptococcus	3	5	1	9
Gram-positive bacillus only	23	28	7	58
Gram-positive bacillus and streptococcus	4	12	21	27
Gram-positive bacillus and staphylococcus	1	2	0	3
Gram-negative bacillus only	0	0	1	1
Total	201	467	423	1,091

The staphylococci and gram-positive bacilli occur much more frequently in the vital than in the pulpless teeth.

TYPES OF STREPTOCOCCI

Of 346 positive broth cultures transferred to blood agar plates, 302 were found to be pure cultures, usually of nonhemolytic streptococci. Only three times were hemolytic streptococci found; twice, in pure culture and once associated with *Staphylococcus aureus*. Mixed cultures were present forty-four times. It is of interest to note that most of the mixed cultures were from positive broth cultures of vital teeth. In the sixty-six cultures from roentgen-ray positive teeth, only three were found mixed, on transfer to blood agar plates. The nonhemolytic streptococci were usually green on blood agar. Not infrequently, the colonies were grey.

For the identification of the nonhemolytic streptococci by fermentation reactions, single colonies were picked from the blood agar plates and transferred to broth tubes. From the broth, after incubation, transplants were made to the various sugar tubes. The results of the determination of type (Holman classification) of 305 strains of nonhemolytic streptococci are shown in Table 4. *S. fecalis*, *S. mitis* and *S. salivarius* are the common strains. *S. salvarius* occurs much more fre-

quently in the cultures from vital teeth than in those from the pulpless teeth.

COMMENT

The results of the cultures reported herewith show only the bacteriologic status of the teeth at the moment the tooth was extracted by a given method of culture. It is quite possible that a culture taken the day before or the day after might yield different results. Likewise, different results may have been obtained using a different technic or different culture material, though the mediums used are the best known for the culture of the nonhemolytic streptococci.

The series is sufficiently large to determine the incidence of infection by the methods used. The chances of error in technic can be determined and allowed for on the results of the vital tooth culture. No attempt is made to answer numerous debated questions in dental bacteriology.

Nine per cent of the broth cultures of the radiographically positive pulpless teeth have shown no growth. Some observers are inclined to believe that all pulpless teeth are infected. There is every indication that the broth negative cultures represent teeth really sterile. In fact, it is difficult to see why an infected tooth may not occasionally heal and become bacteria-free just as infected areas in other parts of the body tend to do.

In determining dental infection, no one method of examination gives all the information desired. Clinical examination of the teeth, transillumination and

TABLE 4.—DISTRIBUTION OF STREPTOCOCCI FROM APICAL BROTH CULTURES ACCORDING TO HOLMAN CLASSIFICATION.

Organism	Vital		Pulpless Radiographically Negative		Pulpless Radiographically Positive		Total	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Streptococcus fecalis	19	33.9	64	48.9	62	52.5	145	47.5
Streptococcus mitis	14	25.0	24	18.3	25	21.2	63	20.7
Streptococcus salivarius	15	26.8	14	10.7	15	12.7	44	14.4
Streptococcus nonhemolyticus I	5	9.0	16	12.2	8	6.8	29	9.6
Streptococcus nonhemolyticus II	3	5.3	6	4.6	4	3.4	13	4.3
Streptococcus nonhemolyticus III	0	0.0	3	2.3	1	0.9	4	1.3
Streptococcus ignavus	0	0.0	4	3.0	3	2.5	7	2.3
Total	56	100	131	100	118	100	305	100

vitality tests each have a place in determining the possibility of dental infection. However, the radiogram is often necessarily the main dependence. This emphasizes the necessity of comparing roentgen-ray findings with cultural findings. The results of our series enable one to have some general idea of the correspondence between the two methods of examination.

The most striking finding here is the high percentage of positive cultures in the radiographically negative teeth. This is not a surprising result. The organisms commonly are of a low grade of virulence so might well be present in the periapical tissue for a long time without producing radiographic evidence of bone destruction. Where there is little local resistance to the infection, conditions are most favorable for blood stream dissemination from such a focus. Forty-six and two tenths per cent of the radiographically negative, and 62.8 per cent of the radiographically positive pulpless teeth showed ten or more colonies. Considering the greater chance of dissemination of the bacteria from the radiographically negative tooth, it is apparent that the two groups are of approximately equal importance from the standpoint of systemic disease. Price[9] has emphasized especially the limitations of the roentgen ray.

The facts presented here should be looked on as information needed in deciding on treatment. The prevention of disease is much simpler than the cure of disease. From this standpoint, it is most desirable to eliminate all dental infection. Mechanical removal of the infection is always the procedure of choice. Often, economic, mechanical or other valid reasons prevent the ideal thing being done. The age and general physical condition of the patient, and the type of systemic disease, must be considered in determining treatment.

It seems especially important that all infection be removed in older persons, regardless of systemic disease, since here resistance is on the wane. Persons of any age who present evidence of focal infection should have all sources of dental infection eliminated. It is important to realize that the elimination of systemic infection, once started, is often most difficult. Too often changes have taken place that cannot be altered.

The determination of the type of streptococcus, based upon carbohydrate fermentation tests, is of little importance. Most of the streptococci fall in three groups. Rosenow has repeatedly emphasized that the streptococcus is the common exciting agent in chronic focal infection. In 963 of our 1,091 positive broth cultures, the streptococcus only was found. Including the cultures in which a streptococcus was found mixed with other organisms, the streptococcus was present in 1,009 of the 1,091 cultures.

SUMMARY AND CONCLUSIONS

In periapical cultures from 1,500 incisors, cuspid and bicuspid teeth, deep tubes of glucose brain broth agar were employed as affording most favorable nutritive conditions and varying oxygen tension, and because the number of bacteria could thus be estimated.

Vital teeth have been routinely cul-

9. Price, W. A.: Diagnosis, Prognosis and Treatment of Dental Focal Infections, J.A.D.A., 12: 641 (June) 1925.

tured to determine the chances of error in technic.

Of 400 cultures of vital teeth, 85.5 per cent were sterile in agar; 4.8 per cent had ten or more colonies; only 1.2 per cent had more than 100 colonies per tube, and 45 per cent were negative in broth. As it is assumed that these teeth were really sterile, the positive cultures indicate in a numerical way the chance of technical error.

Of 500 pulpless teeth with a positive radiogram, 26.6 per cent were sterile in agar; 62.8 per cent had ten or more colonies; 44.2 per cent had more than 100 colonies, and 9 per cent were sterile in broth.

The cultures of 600 pulpless teeth with negative radiogram showed 44.3 per cent sterile in agar; 46.2 per cent containing ten or more colonies; 25.7 per cent 100 or more colonies in the agar tubes, and 16.8 per cent sterile in broth.

For comparative purposes, the number of tubes containing ten or more colonies is most valuable. Four and eight tenths per cent of the vital group, 62.8 per cent of the pulpless teeth with positive radiogram, and 46.2 per cent of the pulpless teeth with negative radiogram showed ten or more colonies per tube.

Nine per cent of the pulpless teeth with positive radiogram and 16.8 per cent of the radiographically negative teeth showed no growth in broth; which suggests that a certain percentage of pulpless teeth are really bacteria free.

The nonhemolytic streptococcus is by far the most commonly found organism. Hemolytic streptococci occur only rarely.

The type of streptococcus as determined by carbohydrate fermentation is probably of little importance from the standpoint of systemic disease. *S. fecalis*, *S. mitis* and *S. salivarius* are the most common organisms.

The high percentage of positive cultures in the radiographically negative group shows that there is a sharp limitation to the translation of radiographic evidence of infection into actual infection.

This study suggests that the roentgen-ray negative tooth may be as important a potential factor in systemic disease as the roentgen-ray positive one.

DISCUSSION

U. G. Rickert, Ann Arbor, Mich.: We are fully conscious of the fact that there are those who have settled the pulpless tooth problem to their own satisfaction, and we wonder why Drs. Haden, Puterbaugh and others are still so intensively studying the subject. It may interest them to know that a rather complete inventory of the present conception with respect to the management of pulpless teeth assures us that, while we still have among us a few of the ultraconservative and ultraradical elements, we have fortunately a large majority who are open-minded and who are patiently waiting for scientific and clinical developments, with the hope of sanely and constructively solving our problem. As individuals and as groups, the dentists have practiced both extremes and have found both inadequate. At the present time, we are not always sure that the diagnosis that must be made is correct. There is consolation in the statement of a great scientist who recently said that only atheists and fundamentalists were absolutely sure of their views, inferring that the more scientific workers are never obsessed with the idea that they are in possession of all the facts. Let us for the moment be optimistic and admit that, if there were no unsolved problems in our field, dentistry would soon become less interesting. One of our most prominent dental educators recently made the statement that he hoped the pulpless tooth problem never would be solved because of its stimulating influence on the profession.

From the patient's standpoint, it is indeed fortunate that the majority of us are at the present time practicing progressive yet reasonably conservative dentistry. While we believe that even the extremists are making their contribution to the development of dental science, it is our opinion that it will ultimately be the position taken by the more stable and openminded group that will finally lead us to a rational solution of the problem. Promiscuous and careless treatment of teeth with involved pulps has been tried out on a large scale, and by past methods, at least, and, when considered as a whole, has proved a miserable failure. Promiscuous elimination of such teeth has also had a fair trial, and likewise has proved most unsatisfactory. There must be a safe lead between these two extremes that will reward us with a higher degree of real dental service. There is abundant evidence that such a lead does exist, and it is the purpose of papers such as these presented by Drs. Haden and Puterbaugh to broaden the course so that it will safely bear greater traffic than present methods permit. Such studies are concerned with fundamentals grounded in the allied sciences, bacteriology, pathology, histology, etc. It is with this part of the problem that Dr. Haden's paper is especially concerned. In view of the fact that I did not receive Dr. Puterbaugh's paper in time, I shall discuss Dr. Haden's paper only and call attention to what in my opinion are its most outstanding features. While I may not entirely agree as to the relative importance of the subject matter studied, I do agree that, in the recent past, these have been fundamentals of importance to our problem. In view of the extensive guesswork that has so frequently been presented to the professional as research, and in view of the frequency with which we have been asked how to evaluate the merits of research reports, we wish especially to call attention to this production as one developed and presented in a scientific way. The investigator, whom I have never had the privilege of meeting before, introduces his subject and then carries it step by step to the final conclusions without elaborate interpretations. While we believe that there are means of control less arbitrarily selective than those presented by Dr. Haden, we are impressed with the painstaking measures of control undertaken in his attempt to determine more accurately just how many pulpless teeth are infected. It has been our experience that some of the periapical tissues were at times infected with only a few organisms so that the control factor used in such cases, if I understand Dr. Haden, would be counted by him as contamination. Then, on the other hand, the large number of organisms often present in a slight amount of contaminating material would be counted as true infection. In Dr. Haden's hands, this method of control may be very helpful, especially if great care is exercised in sterilization of the field previous to extraction. In my experience I believe that the most reliable method of taking cultures with negligible contamination is either by the window method or through the tooth, culturing through the tooth being preferable where permissible. The latter is applicable only where the tooth crown is intact and the culture can be taken through sound tissue to the pulp canal. In this way, the instruments and orifice in process of opening can be repeatedly sterilized until the pulp chamber is entered. This cannot be accomplished through carious dentin tissue, but many single rooted teeth with dead pulps under silicate fillings have been cultured successfully in this way. Often, in these cases, the pulp canal contents will be found negative, while the aspirated periapical tissues will be positive. Such measures and results give us a reasonable degree of control. This method also reveals the real point of infection at the time the culture is taken. Our final results we would have you understand are not far enough removed from those of Dr. Haden's to be of disturbing significance. The point we wish especially to emphasize here is that greater progress will be made with the solution of our problem when all students of the subject cease to be influenced by presentations in which only the supposed end results are given. Our literature contains too many guesses in which the contributor seemed to live in hope that someone better qualified would supply the details of the experiment, so that it could be said, "We did that years ago," when, in fact, this was but a guess. There is no use in trying to verify these incomplete reports, for, if one fails, the dreamer at once says that it is failure in technic, that the real investigator

has failed to comply with one or another condition, and, by such tactics, it is possible to filibuster the real issue indefinitely. There always will be discrepancies supposedly emanating from the laboratories if, as a profession, we continue to regard incomplete reports on a par with more painstaking work such as Dr. Haden has given us in his paper. Dr. Haden had no fear in giving the details because he knew that, under similar conditions, the work could be duplicated, whether in Kansas City, Chicago or Ann Arbor. In the main, our laboratory results are identical with those of Dr. Haden. The differences in our percentages can readily be accounted for by the variations in technical procedures and in the selection of cases. As stated earlier, there may be some differences of opinion as to the relative importance of the subject matter studied. For instance, from the splendid effort made to know more accurately the approximate percentage of pulpless teeth that are actually infected, one must believe that Dr. Haden still considers such accuracy highly essential and, from a research point of view, it is, but in our opinion, sufficient work has been done by Dr. Haden, by us and by others, with sufficient accuracy to demonstrate beyond a doubt that too many teeth treated by past methods subsequently become infected. Personally, then, we are but little concerned whether the percentage of treated pulpless teeth that are actually infected is 41, 51 or 61 per cent. What concerns us far more at the present time is what the essential factors are in assuring that those not infected remain aseptic. Such information is fundamental and highly important, for the rational development of technical procedures. I desire especially to call attention to the fact that, contrary to the general impression, Dr. Haden does recognize the necessity of treatment in favorable cases, for he says in his introduction "the dentist needs such data in deciding on methods of treatment." In the rather distant past, it was common practice to estimate the amount of infection from the extent of rarefaction about the root end as observed from the radiogram. We, too, went through that misguided stage and were only disillusioned after culturing many teeth. Drs. Price, Lyons and many others, as well as I, have so often referred to the limitations of the radiogram that we were of the opinion that only a few physicians and many professional radiographers were still determining the presence and extent of infections from radiograms. Dr. Haden is correct when he calls attention to the fact that many teeth without radiographic evidence of rarefaction are infected. We must not be misled, though, into the belief that all teeth presenting negative radiographic evidences are infected, because teeth successfully treated also present such evidence. It has been our experience to find infected nearly all inadequately filled negative radiographic apical areas in arthritic patients. We should also emphasize the fact that the radiogram cannot be depended on to determine whether root fillings are successful. It is only a valuable adjunct. Many times during our culturing we found teeth that appeared well filled radiographically but in reality failed to seal any part of the canal. There is another phase of Dr. Haden's work quite in harmony with our results. We, too, found a much higher percentage of apparent localizations when more time was permitted between inoculation of the animal and necropsy than was suggested by Dr. Rosenow. Cultures taken during the exacerbation period appeared to localize more frequently than if taken from chronic cases. Since we have obtained cultures from vital pulps with apparent localizing properties, we suspect such infection to be secondary as a result of an overflow from some primary focus. In such cases, it is quite possible that blood cultures taken at the right time would have proved the presence of the same organisms. We also suspect that traumatized pulpless teeth are at times infected by metastasis. Such infections may disappear again under favorable conditions. There is no limit to where extraction would end were one to carry this point to its final conclusion. While elective localizations can be strikingly demonstrated at times, thus far to us its significance is but of little more than laboratory interest. One may find cases in which cultures taken from the first teeth extracted will present seeming specificity, but if the remaining pulpless teeth are extracted at a later date and are found positive, the latter may not localize at all, demonstrating, at least, the passive localizing powers, producing biologic factors affecting the organism not as yet understood.

In peptic ulcer, specificity appears to be more permanent. The animal lesions are usually not typical peptic ulcers in that they appear often as multiple abscesses. The more we study the question, the more we realize that we are dealing with a biologic, chemical problem. We have been talking in terms of bacteria when all signs indicate that we are more especially concerned with the protoplasmic make-up of the individual. Just why nine out of ten persons will not take diphtheria from the same contact that will confer the disease to the tenth member is a biologic problem. Just why some patients are not made seriously ill with the dental bacteriologic laboratories within the pulp canals of teeth they possess is also a biologic problem not as yet understood. The solution may be as simple as Dr. Price would have us believe from his conception of the calcium balance. We hope his idea, not at all an impossible clue, will prove correct, but we suspect a much more complicated set of conditions must be mastered before we reach the final solution. We may well ask what has been accomplished at this meeting. To me, the most outstanding single factor on which it would appear that we could all agree is that too many teeth treated by past methods have subsequently become infected, for we want to reduce infection, whatever our idea of tooth conditions as etiologic factors in disease may be. The most constructive program for research demands that ways and means be devised for the refinement of technic and for the more successful management of pulpless teeth, or the practice may have to be abandoned. There has been a certain amount of just criticism that there is too much duplication of work. Dr. Price never made a more truthful statement than when he said, "Original work is but a suggestion until someone else has been able to duplicate it." This is true, but let us avoid carrying it too far. For instance, the typing of organisms of dental infection has been shown to be insignificant by Hartzell, Price, Haden, Hatton and me. Why spend more time with it? The momentous dental problem of the day is plainly this: Can methods be devised for the safe retention of pulpless teeth of strategic importance or is safe treatment by the most painstaking dentist impossible? I am convinced that suitable treatment is often the greater service. Whether the profession will take the pains to refine the clinic on a large scale is still to be proved.

Dr. Haden, I hope we may enlist you in the bacteriologic aspects controlling the various technical procedures that must be devised if we are going to give our patients the real health service all of us most desire.

PULP CANAL THERAPEUTICS*

By P. G. PUTERBAUGH, D.D.S., M.D., F.A.C.D., Chicago, Illinois

I SHALL endeavor in this paper to present some of the findings and results obtained in the removal of dental pulps and the treatment and filling of pulp canals as disclosed by clinical statistics compiled in the clinic of the Chicago College of Dental Surgery.

It should be understood at the outset that all of the treatments were given and canal fillings made by students, and while great care is exercised in supervision, the end results of treatments should hardly be considered as favorable as those obtained by the more skilful practitioners of experience.

For the last few years, we have made it a rule to extract all pulpless teeth that show areas of periapical decalcification, in those patients who are suffering from systemic diseases that are held to be the probable result of focal infection; viz., arthritis, neuritis, myocarditis and endocarditis, etc. In addition to this conservative practice, we hesitate to treat and fill pulp canals in teeth that have tortuous or inaccessible canals as shown by radiograms taken preliminary to all treatments.

Each tooth requiring pulp canal treatment is radiographed at the first sitting. This radiogram is of definite assistance in determining the form and accessibility of the canals. It also permits a more positive diagnosis of the condition of the periapical and peridental tissues and has served to prevent much loss of time in the treatment of pulp canals that were inaccessible or of teeth whose apices are hopelessly involved in periapical infection.

When, in 1917, a report was presented before the National Dental Association asserting that no drug sealed in pulp canals would completely sterilize these canals, there followed a period of turmoil regarding the safety of treating and filling pulp canals that undoubtedly resulted in the formation of the group advocating the 100 per cent elimination of pulpless teeth. Since that time, clinical records compiled in numerous localities have disclosed a rather amazing line of definite information that is bound to have an important bearing on the ultimate solution of the problem.

Pulp canal therapeutics is divided into two general groups of cases: namely, those teeth containing vital pulps and those having nonvital pulps. The extirpation of vital pulps and the insertion of satisfactory pulp canal fillings is most interesting to us since those cases give a higher percentage of favorable results following treatment. We clas-

*Read at the Midwinter Clinic of the Chicago Dental Society, Jan. 27, 1926.

sify the nonvital pulp cases as the teeth having gangrenous, periapical abscesses or those containing incomplete pulp canal fillings with slight or no periapical decalcifications. The pulpless tooth group comprises less than 30 per cent of all of our cases receiving treatment. In 70 per cent of all cases, the removal of vital pulps is demanded.

The reparative power of the periapical tissues as influenced by the patient's general health has for years been ignored by the entire profession, and radiographic examinations disclose hundreds of teeth with incomplete pulp canal fillings which for years have functioned to everyone's perfect satisfaction, without any evidence of systemic disease or roentgen-ray showing of the development of pathologic conditions. These patients must have good resistance to infection. It therefore behooves us not to ignore the general condition of the patient's health in evaluating the case of the pulpless tooth. We believe, too, that often the overzealous operator, in his efforts to secure perfect fillings, is likely to injure the periapical tissues mechanically to an irreparable degree so that the radiogram will for years disclose an unrepaired decalcified area beyond the root apices.

In all our manipulations within pulp canals, the thought of working with Nature and not against her should dominate us. The age of the patient seems to be an important factor, since the progressive development of cementum about the apices of the roots, narrowing down the apical foramina as the age of the patient advances, assists materially in the mechanical sealing or plugging of the apical foramina after the pulp has been removed. The large canal with the wide open apical foramen in the tooth of the child is easily negotiable with a broach throughout its entire length, but the apex presents a difficult problem when it comes to inserting a serviceable filling. Unless unusual precautions are taken during the cleansing process, the broach will pass through the foramen, wounding the periapical tissues. A portion of the filling material will then probably protrude beyond the foramen, later to render the tissues susceptible to bacterial infection.

In the development of the pulp canal, the cementum constricts the foramina and the deposition of dentin within renders the canal smaller and more tortuous. On the one hand, this complicates the problem of cleansing such canals as they then require enlargement with broaches, files and reamers, assisted by the use of phenolsulphonic acid (aseptol) to shape them to proper form for the reception of the filling material. On the other hand, it facilitates the operation of adapting the filling because the foramina are constricted; which assists in the condensation of the filling material at the apex. The size of all canal broaches and cleansers used should correspond relatively to the size of the canal, as a fine broach in a large canal may pass beyond the foramen without the operator's realizing that injury is being done to the periapical tissue. When a suitably selected broach is inserted in a pulp canal, the point stops at the constriction without protruding beyond the end of the root and the entire pulp adheres to the broach on its removal. This condi-

tion also enables us to measure the exact length of the canal and assists in the selection of a proper guttapercha cone for filling it.

While in the treatment of older patients there is less risk of periapical tissue injury, there is always the question of lessened immunity to infection that must be considered, and greater care in taking the patient's general history is necessary.

Our clinical records show that the periapical tissues in 90 per cent of all complete pulp canal fillings, when judged by radiographic evidence six months or more after the fillings have been inserted, are normal. In underfilled canals, less than 20 per cent are normal after six months and the overfilled ones show less than 10 per cent radiographically normal after six months. These records include all types of cases treated and should be interpreted as giving relative values only. Unfortunately, the radiographic and clinical examinations are the only means which we possess of determining any deviation from the normal, for at present we know of no satisfactory cultural method of determining the presence or absence of bacterial infection in these areas.

Treatment of pulpless teeth should not be extended over a prolonged period of time as the promptness with which a canal can be sealed after the removal of the pulp in a great measure favorably influences its chances for success. One great menace in the treatment of pulp canals lies in the possibility of bacterial contamination during the course of treatment. This danger increases proportionately with the number of times the canal is opened and with the amount of instrumentation. Since the therapeutic action of antiseptics in pulp canals decreases quite rapidly, prolonged treatment is undesirable. The immediate closure of wounds without breaking down the exposed surfaces with antiseptics is practiced in other good surgery—why not here?

PRESSURE ANESTHESIA

Pressure anesthesia is employed only in those teeth having exposed vital pulps and in which it seems that pathologic changes have not extended beyond the stage of passive hyperemia. This method is used successfully by students in single rooted teeth, but it is not satisfactory in multirooted teeth, because it fails to allow sufficient working time for the student to remove the pulp thoroughly. In those pulps in which the circulation is normal as determined by the history and clinical findings, yet which are in contact with leathery decay and therefore infected, a preliminary treatment of phenol compound is sealed in the cavity for twenty-four hours preceding the application of pressure anesthesia. Clinical evidence has convinced us and others that this preliminary treatment is necessary because its use has resulted in a reduction in the number of cases which later evidence radiographically decalcification in the periapical tissues.

At the second sitting, all carious material is removed, and pressure anesthesia is induced by the use of a saturated solution of procain made in physiologic sodium chlorid solution. After careful instrumentation, care being taken not to invade the periap-

ical tissues, the pulp is removed with barbed broaches and pulp canal files. The canal is next flooded with phenolsulphonic acid for the purpose of disintegrating any remnants of pulp tissue that broaches have failed to remove, care being taken not to force it through the apical foramen. The acid is neutralized, after wiping out the excess with aseptic paper points, with 10 per cent solution of sodium bicarbonate followed by sterile water. An effort is next made to dehydrate the canal with alcohol, aseptic paper points and hot air, and if it is possible to secure dryness, the canal is filled immediately. If apical seepage of blood or serum is persistent, a dressing of eucalyptol is placed in the canal and the patient is dismissed for four or five days. At the next sitting, it is usually possible to obtain dryness, and the canals can be filled.

CONDUCTIVE ANESTHESIA

In removing vital pulps that we diagnose by their history to have undergone moderate pulpitis, and for hyperemic pulps in multirooted teeth, conductive anesthesia has proved to be most satisfactory. If pulpitis is present, it permits of the immediate relief of pain. The epinephrin in the solution contracts the blood vessels in the region so that little difficulty is encountered in arresting hemorrhage or seepage of serum after the pulp is removed, making immediate canal filling possible. In the lower molars and bicuspids, the classic mandibular injection is always performed. For the lower incisors and cuspids and for the teeth in the upper arch, infiltration on the buccal or labial surfaces over the apices of the roots is practiced, in which the anesthetic is carried into the periosteum. Infiltration of 1 c.c. of 2 per cent procain solution is quite satisfactory. Anesthesia occurs in from five to ten minutes after the injection and lasts for a full thirty minutes. This method does not force infection from within the pulp canal into the periapical tissues, but rather prevents its being carried there through the vasoconstrictor action of the epinephrin in the anesthetic solution. Quite the reverse of what is usually expected from this treatment, we find that less damage is done by students to the periapical tissues than in any other type of root canal procedure, and our records show that we have less overfilled canals from this than from any other method of removing vital pulps. When we consider that the checkup radiograms show areas of bone decalcification about nearly all overfilled canals, this fact becomes important. Teeth so treated rarely develop symptoms of pericementitis or other discomfort.

DEVITALIZATION

Arsenical paste has been used in approximately one-half of the cases treated in our clinic during the last three years. It is the method of choice for removing vital pulps by the beginner, since it affords him ample working time in which to gain access to the canals and to remove their contents. This attitude on the part of students is now changing, so that after they have treated and filled a few pulp canals, students are inclined to abandon this method for the more rapid and more

satisfactory local anesthesia. Our records show that, after periods varying from six months to three years, we have almost 38 per cent of teeth so treated displaying areas of bone decalcification in the periapical tissues. The fact that more than 60 per cent of teeth whose pulps have been devitalized by arsenic show normal periapical tissues after months and years leads us to believe that ill-results are probably due to faulty filling and reaming technic and not to the method of pulp destruction or the medicaments employed. If the agent was as dangerous as some writers would have us believe, 60 per cent of teeth would hardly escape as they do.

PULPLESS TEETH

As stated, we only attempt the treatment and filling of canals that are infected in those cases in which radiographic evidence indicates that the peridental membrane in the apical region is not destroyed. We advise against the treatment of pulpless teeth that have lost their apical pericemental attachment. We treat all teeth containing putrescent pulps in healthy patients when the radiogram indicates a fair chance of gaining access to the pulp canals in their entirety and when the apices of the roots have not become denuded.

In the management of canals filled with putrescent material, the first treatment consists in gaining access to the orifices of the canals by widely exposing the pulp chamber; next, washing away the liquefied material and evaporating the semiliquid contents of the canal by blasts of hot air. Formocresol, employed as a routine disinfectant, is applied on cotton pellets and sealed by covering with a thick layer of a high grade cement. After forty-eight hours, the medicament is removed, and the entire contents of the pulp canals is removed mechanically with broaches, reamers, files, etc. Phenolsulphonic acid is then carried into the canals with a broach to assist in their enlargement. Its softening effect on the interior of the canals makes the cutting with barbed broaches much more rapid and effective. After neutralization of the acid with 10 per cent sodium bicarbonate solution and desiccation with blasts of hot air, another application of formocresol is carried well into the apical one-third of the canal on bibulous paper cones, and is sealed in with cement for another forty-eight hours. If on its removal, all odor of putrescence is absent, a test application of eucalyptol compound is placed in the canals on paper points and sealed in with cement for one week. If on the removal of this dressing, putrescence is still present, formocresol would again be placed in the canal instead of eucalyptol compound, and then, at the following sitting, eucalyptol compound would be placed therein for one week for a final test before inserting the pulp canal filling. Any pulp canal that does not lose its putrescent odor after three treatments with formocresol should be condemned, because it is practically certain that the apical portion of the root has lost its peridental membrane and that the cementum is saturated with putrescent material. This infected cementum about the apex of the root, even though rendered sterile, would still remain as an irritant to the soft

tissues resting thereon and would invite a recurrence of infection.

In a few selected cases, we have tried the irrigation and treatment of putrescent canals with iodin and with chlorin preparations, but from a clinical point of view have not been favorably impressed by the behavior of canals so treated. The odor of putrescence has been more persistent when these remedies were used than when formocresol was applied.

While we never seal formocresol in sterile empty canals, but use it to the exclusion of almost all other remedies in canals containing putrescent material, we have not found it to be destructive to the soft tissues beyond the apical foramina, nor have we experienced symptoms of drug pericementitis following its application. We have also used it for the purpose of tanning or hardening pulps that have been recently devitalized by arsenic, but have not yet become detached from the vital tissues at the apices of the roots; also in those that are without clinical or radiographic evidence of injury. Our records show that many teeth which originally presented clinical evidence of putrescent canals and radiographic evidence of bone decalcification at the apices of the roots, after a six or twelve month period, exhibit a very flattering periapical tissue improvement in the way of bone regeneration.

ASEPSIS

Perhaps the greatest advance that has been made in pulp canal treatment in recent years is along the line of the establishment of a technic of aseptic procedure. Here, we differentiate from ordinary cleanliness, which consists merely in the prevention of the transmission of infective material from one patient to another. Ordinary cleanliness simply demands that instruments which come in contact with one patient be sterilized before they are used on another, and that the operator's hands be washed with soap and water, and little attempt is made to prevent the contamination of the field by the patient's own bacterial flora.

The aseptic technic that we have adopted demands that all instruments and materials used on the patient after the rubber dam is adjusted be boiled or disinfected just prior to their use; that they be arranged on a napkin which has been sterilized in the autoclave and that all cotton pellets, bibulous paper points, diagnostic wires, etc., be rendered sterile in an autoclave or by immersion in an antiseptic solution. The operator's hands must be scrubbed thoroughly with soap and water, and even then they are not permitted to come in contact with the working points of instruments that are used in pulp canals, but must touch only the handles of such instruments. Tincture of iodin is painted over the field of operation, which includes the rubber dam, clamps and crowns of the teeth adjacent to the one on which the work is done, as well as the tooth under treatment. With this preparation it is possible to adopt an aseptic routine that is quite efficient. Burs are inserted in the hand pieces by the use of tweezers, and no handling of the burs with the fingers is permitted. Aseptic bibulous paper points are used for absorbing moisture from pulp canals

and for the purpose of applying medicinal agents to them.

By the adoption of a carefully studied routine, we have been able to reduce the average number of treatments for the purpose of filling canals that have been putrescent to three, and, in those cases that show a certain amount of decalcification beyond the apices of the roots, to four treatments before the canal fillings are inserted. No treatments of any kind are applied without securing an absolutely sterile layout on a 9 by 14 inch tray, with the occasional exception of the sealing of an anodyne, such as oil of cloves or phenol compound, as a preliminary dressing twenty-four hours before a vital pulp is to be removed under anesthesia.

Much confidence is placed in the thorough instrumental removal of pulp tissue whether infected or otherwise, since it is our belief that the removal by this method is preferable to any attempt which we could make toward its disinfection or chemical neutralization.

We have had little experience with electrical dissemination of drugs and are therefore not in an authoritative position to speak on the subject of electrolysis, for which some investigators are now making extravagant claims. Likewise, the use of the violet ray by means of a quartz lamp has not offered us sufficient evidence of therapeutic efficiency to merit enough confidence for a trial.

A rather interesting disclosure that the regular checkup which we make of our root canal fillings has given is that, while about one-third of the total canal fillings show areas of decalcification in the periapical tissues, there are seldom any local signs of discomfort in the teeth, and the areas are rarely sufficient to merit a condemnation of the teeth.

Our method of checkup on pulp canals following treatment and filling is to mail a postcard to our patients at six-month intervals following treatment, explaining to them the importance of observation and offering, without charge, roentgen-ray service to determine the condition of the teeth which have been treated. In spite of this rather generous offer, only 15 per cent of our patients can be induced to return for this examination. Our statistics as to late changes occurring some time after the filling of pulp canals, therefore, are based upon the findings in the 15 per cent that return for such examination. We feel that this condition could be improved in private practice, but in our clinic these are the best returns that we have been able to obtain.

As the clinic is running at the present time, we are averaging about 2,400 pulp canal filling cases a year. For the year ending June 1, 1924, they were divided as follows: 1,100 cases of devitalization of vital pulps with arsenic; 300 cases of pulp removal under pressure anesthesia; 300 pulp removals under hypodermic infiltration. Six hundred cases were of gangrenous pulps, including a few dental granulomas; nineteen cases of acute alveolar abscess, and 200 cases of retreatment of teeth that had previously been treated and contained imperfect canal fillings.

Of the 2,400 teeth treated in 1923-1924, 355 were submitted to subsequent

radiographic examination. Of the 355 teeth, 160 showed perfect canal fillings. The 160 teeth contained 271 canals, indicating that many of them were molar teeth. Five of the 160 showed regeneration of areas that were present in the original radiogram. Twelve per cent of the perfect canal fillings showed involvement in the apical region. Eighty per cent of the teeth with complete pulp canal fillings showed normal periapical tissue. In this series, sixty-eight teeth containing 140 pulp canals showed incomplete canal fillings (molars). Of these, 40 per cent were normal, and 60 per cent had periapical involvement. Thirty-two per cent were overfilled, some of the guttapercha being forced beyond the apical foramina. Of those that were overfilled, 16 per cent were normal, and 84 per cent showed periapical decalcification. Of the pulps removed by arsenical devitalization, 60 per cent showed normal periapical tissues. Of the pulps removed under pressure anesthesia, 61 per cent showed a normal condition.

From these statistics, it is evident that even though unusual care is taken in the early diagnosis of the cases undertaken for treatment and in not attempting to treat teeth whose apical regions are located in badly infected areas, radiographic evidence would indicate that approximately one-third of all teeth that are filled show definite areas of bone decalcification after six months or more has elapsed from the time of filling the canals.

Immediate pulp canal treatment has only been practiced by us to any considerable extent during the past year, and statistics are therefore wanting as to the end result of such treatment, but the indications at present are highly favorable.

Since those teeth that show good canal fillings have a much better chance of being retained without evidence of irritation, and the evidence now being accumulated indicates that a much higher percentage of good pulp canal fillings occur in the immediately filled group, it seems fair to assume that a higher percentage of successful cases will be the ultimate result from this group than from those in which any of the other modes of treatment were employed. It would appear, from a careful study of our radiograms, that it is better to underfill slightly than to overfill canals; also, that the sooner a canal filling can be placed, in order to seal hermetically the apical foramina before the periapical tissues show circulatory changes, the greater the chance will be of its being retained without radiographic evidence of irritation.

FUNCTIONS OF THE OCCLUSAL SURFACES OF THE TEETH*

By HARVEY STALLARD, Ph.B., Ph.D., D.D.S., San Diego, California

Occlusion—Occlusion, a word of Latin origin (abclaudere, obclaudere, occludere) meaning "shutting up," has been used by certain writers to denote the normal closure of the teeth; by others, to mean any sort of jaw closure.

Function.—It must have been inferred that teeth lack function in certain closures, or we would not now be calling dental articulation "functional occlusion." Function, originally denoting action, has now come to signify also the *being* of something physiologically (Century Dictionary, 1906). Teeth in centric occlusion function passively; for such a position tends to preserve the relationship of the teeth and jaws and probably rests certain muscles. The occlusal surfaces, mere instruments, used chiefly in eating, but much in speaking and in maintaining occlusion, have only passive function.

Occlusal Surfaces.—The occlusal surface, as defined originally by Black, is only that surface of a bicuspid or molar tooth which makes contact with a tooth of the opposite jaw when the mouth is closed.[1] But large areas of unworn occlusal surfaces usually lack such contact in adolescence, and the cuspal zones of the buccal surfaces of the mandibular buccal cusps and those of the lingual surfaces of the maxillary lingual cusps are also occlusal areas, though, according to Black's descriptions, they lie outside the buccal and lingual marginal ridges, respectively (Fig. 1). Besides, attrition extends the occlusal surfaces to all sides and substances of the crowns. No doubt well sculptured teeth of youth, having maximum function, are the true patterns for most dental restorations, since they have complete occlusal surfaces.

Control of the Occlusal Surfaces.—Appreciation of the importance of such occlusal sculpture grows with a study of mastication. The tongue, cheeks, lips and masticatory muscles make the teeth function. The tongue warms or cools foods and can crush flesh of fruits

*Read before the Section on Partial Denture Prosthesis at the Sixty-Seventh Annual Session of the American Dental Association, Louisville, Ky., Sept. 24, 1925.

*The late Dr. Frank Wadsworth first interested me, in 1922, in this work by showing me that artificial and natural molars chopped food into pieces by multiple incision. Since then, Dr. B. B. McCollum has urged me to describe more accurately what Dr. Wadsworth taught. Dr. Spencer Atkinson, by methods of comparative anatomy, showed in a clinic, in July, 1925, at the annual convention of the Southern California Dental Association, that chewing is in various animals done by multiple shearing.

1. Black, G. V.: Dental Anatomy, 1894, p. 14.

and breadstuffs between itself and the hard palate or the upper teeth. By rolling the particles forward or backward, it selects the food, and, by rolling

By taking advantage of the outward swing of the mandible and the simultaneous compression of the cheek, it, like a steam-dog of a sawmill rack,

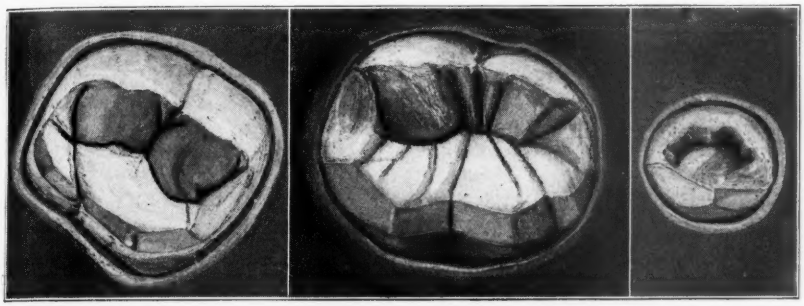

Fig. 1.—Lower bicuspid and upper and lower molars, showing attritional areas extended beyond the occlusal surfaces.

the bolus in between the occlusal surfaces, it helps to mix the morsels with saliva and to rearrange them for new clenches. It can clean the labiobuccal pouches, the embrasures and any occlusal surfaces lacking opponents. By pushing food against the palate, it excites the palatal mucous glands, which exude the slickest oral lubricants

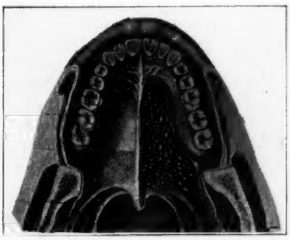

Fig. 2.—Hard and soft palate, with the palatal glands on the right side exposed. (After Kopsch.)

(Fig. 2), and by expanding in all directions during swallowing, it helps to determine the alinement of the teeth. rolls the bolus on the right side counterclockwise, but on the left, clockwise.

The maxillary lip may sweep particles downward so that the mandibular lip, by tumbling them backward, can throw them between the incisors. The lips are more freely prehensible than the cheeks, which, unassisted by the tongue, cannot move food backward, but can move it inward or forward, even out of the mouth. The lips and cheeks also supply a certain amount of saliva directly and intermediately.

The lips, cheeks, tongue and jaws of an edentulous man, or of animals naturally devoid of teeth or their analogues, can masticate food somewhat, but have maximum skill when provided with well sculptured occlusal surfaces in normal occlusion. These muscular organs are probably more important in determining, developing and maintaining occlusion than the occlusal surfaces, since they are active governing factors.

Fitness of the Occlusal Surfaces.—Teeth, compared with knives, are dull.

Their wedge-shaped blades and cusps, by splitting and tearing foods, squeeze out juices, starch kernels and sugar crystals from the cell walls—a hulling process. Only a few cut cells of food, finely chopped by sharp knives, release their contents, but, when mangled by chewing, many more exude their inclusions. Since a large part of all cells is water, chewing quickly reduces the size of a mouthful to a small bolus of fibers, gluten or pulp. Were the teeth as sharp as knives, they would damage the soft organs, preventing their maximum service to the occlusal surfaces, which, in turn, would not hull plant cells so well nor so rapidly.

Adaptation of Teeth to Many Foods, Not to One.—It has been man's misfortune when, in poor environments, he has had to live chiefly on unground grains and seeds or their milled products seasonally. Culinary processes, by moistening hard materials, facilitate occlusal shredding. Grit in food, like that in Indian stone-ground meal, destroys teeth, leads to pulp exposure and neither prevents decay nor favors thorough mastication. Since man lives better by freely eating both fleshy and nonsucculent, gritless plant and animal organs, it is reasonable to suspect that hardness, dryness and grit in breads or raw grains are bad qualities, and, even when they are removed, he must not live exclusively on seeds or grain products. The occlusal surfaces are adapted to masticate many raw plant and animal tissues.

Use Destroys the Occlusal Surfaces.—The fact that the occlusal surfaces, formed months before having any masticatory function, do not grow after eruption disproves the oft-repeated alleged axiom that increased function always produces increased growth, a claim which, as regards the occlusal surfaces, is probably true only phylogenetically. Masticatory function in the individual destroys the occlusal surfaces. Less destruction is caused when they occlude well, chew proper foods and are not milled away by gritting and clenching habits.

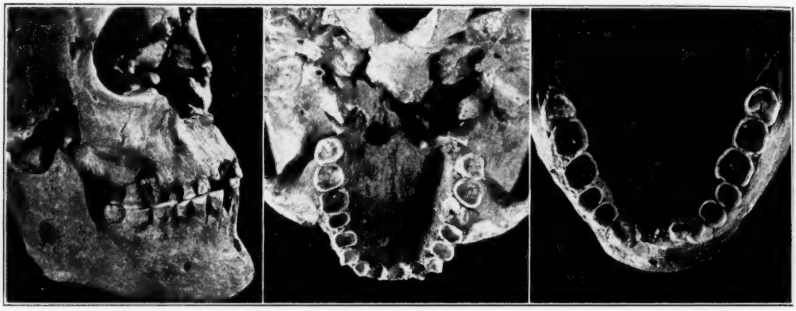

Fig. 3.—Denture of a Los Angeles "fossil" man, showing excessive wear of occlusal surfaces. (Donated by Edgar L. Hewitt.)

THE PROCESSES OF MASTICATORY COMMINUTION

The General Processes.—The four kinds of teeth are said to represent different adaptations; namely, the in-

cisors for cutting, the cuspids for tearing, the bicuspids for chopping and the molars for grinding. Each form can tear, split, incise, chop, crush or grind food, even in a young denture, and, in a worn denture, the molars will not grind much better than cuspids and the incisors, nor will the incisors shear any better than molars (Fig. 3).

Mastication in a young denture is not like the trituration of a pestle and mortar nor of smooth millstones, but the food is torn, split, crushed and cut by multiple incision.

Simple Incisions.—Simple prehensile incision, done ordinarily by the incisors, but, when the food is tougher, by the cuspids, the corners of the mouth presenting so that the hand can pull downward, is still used on breads, celery, green onions, radishes, candy, cheese, apples, fowl, meats, etc. The incisors do considerable chopping, even though the food be introduced by a spoon or fork; for the mouthful is pushed in between them until the size of the particles are small enough for the molars. In biting off succulent vegetables or fruits, the incisors of both jaws pass through the food, the mandibular traveling about twice as far as the maxillary—provided the material has even texture—and, before the edges of the teeth meet, the incised portion pops into the mouth, usually broken into two or more large pieces loosely held together by the skin or strands (Fig. 4). This is a tearing and splitting process. In tougher fibrous foods, the incisors, by protruding slightly, cut like scissors. When the maxillary incisors overhang the mandibular considerably, incision without protrusion resembles a chiseling process, the former teeth corresponding

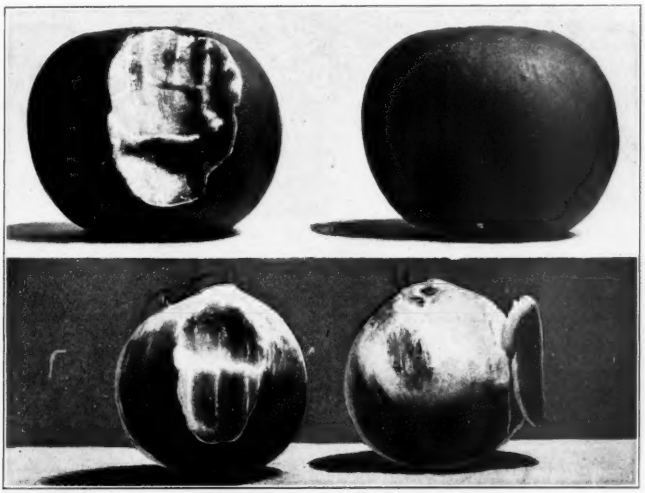

Fig. 4.—Above: Left: Apple from which a bite has been taken, the portion cut by the inferior incisors up. Right: An unmarred apple. Below: Left: Turnip from which a bite has been taken, showing that the inferior incisors pass through the food further than the superior. Center: Same turnip viewed in profile. Right: Lingual aspect of the morsel.

to plane-blocks, the latter to chisels (Fig. 5).

The Amount of Overbite and Its Causes.—How much overbite is normal is a much mooted question. The rule followed in plate denture construction states that the amount should equal the overjet of the buccal cusps. The cause of the natural overbite variation is unknown. Some orthodontists, assuming that the overbite is regulated by the length of the molar cusps, believe that a lack of vertical molar development, presumably from masticatory disuse, causes the overbite. I should think that the overbite would vary according to malformations or variations of one or all three of the following: *corpus mandibulae*, *angulus mandibulae* and *os incisivum*; all three of which, I believe, may be deformed by environmental pressures. The simplicity of the incisors affords the means for considerable variation without pathologic change. In prehistoric man, the incisors met end-to-end, in simulation of the incisal relations of many other animals particularly of the man-like apes, whose long canines no doubt were among the governing factors (Fig. 6).

Incisal Trituration.—Communition by molars has often been likened to mortar trituration, a process of macerating materials by rubbing them between hard objects. A person having a dull denture with some overbite can incise tough sandwich meat by rubbing it several times between the incisors, a trituration process, the mortar areas being in the lingual surface of the maxillary incisors, the pestle surfaces on the rounded edges of the mandibular incisors (Fig. 7). By having such a subject chew a piece of matchwood between his molars a hundred times and comparing it with a similar piece pestled a hundred times between the incisors, it will be found that the latter are more effective. This sort of chewing is done vertically or laterocentrically (the former is more efficient), and is regularly used in completing incision, but often employed also in selective chewing, that is, decid-

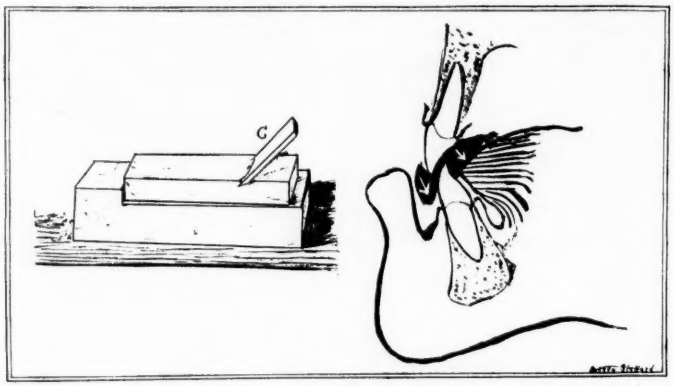

Fig. 5.—Chisel and holding-block, and cross-section of the mouth in the act of biting a morsel of food, showing that the incisal relations when the over-bite is considerable simulates the relationship between the chisel and block.

ing whether the food should be eaten or spit out.

Incisal Wear.—In the decline of an overbite, there are formed on the lingual surface of either maxillary central incisors two attritional areas, each a concave spherical triangle (Figs. 8 and 9). The mesial triangle is bounded incisally by about three-fourths of the cutting edge of the central incisor, mesially by the unworn part of the mesial marginal ridge and distally by a raised line, the impression of the occlusal embrasure between the mandibular central and lateral incisors. The mesial marginal ridge of the maxillary central incisor is worn by the labio-incisal edge of the mandibular central incisor labio-incisal edge; its distal marginal ridge, by the mesial one-half of the labio-incisal edge of the mandibular lateral incisor, which mills-in the crescent-shaped distal attritional triangle, whose base is at the cingulum and apex at the disto-incisal angle of the tooth.

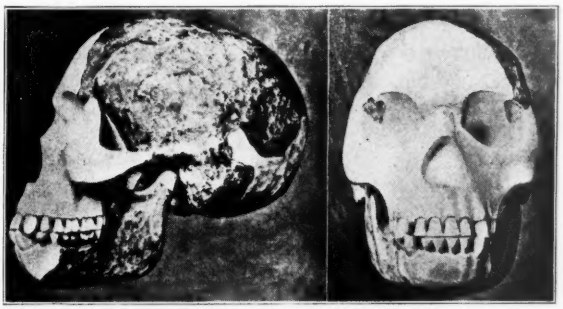

Fig. 6.—Restoration of the skull and mandible of Eoanthropus Dawsoni. (From Dawson and Woodward.)

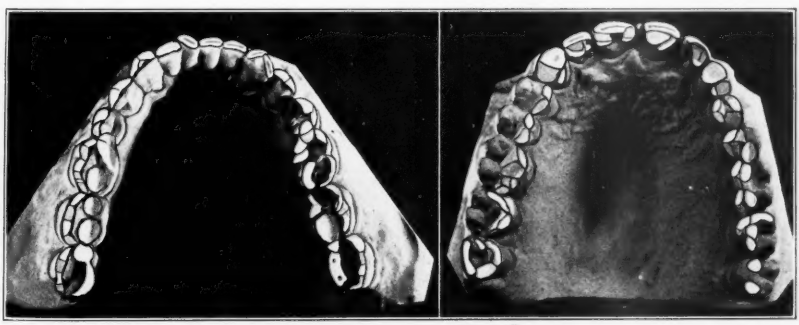

Fig. 7.—Occlusal surface of denture in a man, aged 57; retouched to bring to better view some of the worn surfaces.

The maxillary lateral incisor's mesial marginal ridge is worn by the disto-incisal angle of the mandibular

lateral. At first, only its distal marginal ridge is worn by the mesiolabial surfaces of the mandibular cuspid, but, later, its distal two-thirds. As wear continues, the maxillary crowns are sheared off linguolabially and the mandibular labiolingually until they close, end-to-end.

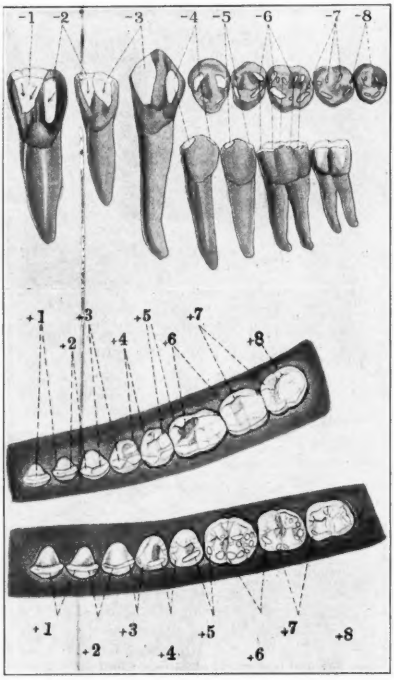

Fig. 8.—Appearance of worn occlusal surfaces.

Simple Shearing of Cuspids and Buccal Cusps.—The cuspids, when used end-to-end, are effective in tearing or splitting large bits of food. Their longer cusps provide a longer shearing stroke than any other buccal cusps. In a laterocentric excursion, the mesial one-third or one-half of the incisal edge of the mandibular cuspid, articulating with the distal articular area of the maxillary laterals, cuts like chiseling incisors, but its disto-incisal edge and articular areas, gliding in contact with the mesial articular area of the maxillary cuspid, cuts more like the blade of a shear. At the beginning of the stroke, the disto-incisal edge of the mandibular cuspid opposes the mesio-incisal edge of the maxillary cuspid, the two thus resembling the blades of a shear having their points directed distally and slightly downward. In like manner, the buccal marginal ridge of the distal half of each of the buccal cusps of the mandibular molars and bicuspids forms a shearing blade with the buccal marginal ridge of the mesial half of its maxillary fellow.

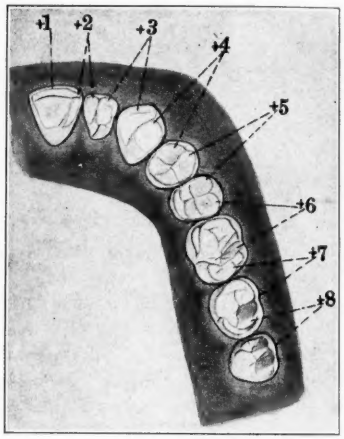

Fig. 9.—Appearance of worn occlusal surfaces.

The buccal marginal ridge of the mesial half of each buccal cusp of the mandibular bicuspids and molars, since it glides under the buccal marginal ridge of the distal half of the maxillary cusp in front of it, cuts food more as do incisors or blades of a pincer.

Where the cusps are longer, these also simulate shears whose blades point downward and mesially.

Attrition of Buccal Cusps.—The mandibular buccal cusps, wearing away faster than the maxillary, often entirely disappearing, allow the overjet to decrease, until the maxillary buccal cusp remnants close end-to-end with the mandibular buccal marginal ridges, and, often, even the maxillary buccal marginal ridges will occlude lingually to those of the mandibular, so that, with continued wear, grooves are made in the mandibular teeth where cusps once stood (Fig. 3). Shearing and incising are now reduced to the minimum; the blades of the "shears" have disappeared, and the worn maxillary cusps, occluding in their own ruts, have only pestle action, less efficient than the former compound shredding and shearing.

Shearing by Supplemental Ridges.—After the buccal marginal ridge of the distal half of the buccal cusp of each mandibular bicuspid passes its opposing maxillary buccal marginal ridge, its distobucco-occlusal angle glides upward on the mesial of the triangular ridge of its opposing maxillary fellow cusp, shutting distally to it; and the tip of the buccal cusp of each mandibular bicuspid cuts with the mesial marginal ridge of its maxillary fellow. On its route to centric occlusion, the buccal marginal ridge of the distal half of the buccal cusp of each mandibular bicuspid meets and passes the mesiobuccal supplemental ridges of its maxillary fellow, so that particles caught between the cusps are sheared more minutely instead of being crammed between the contact points.

The buccal marginal ridge of the mesial half of the buccal cusp of the second mandibular bicuspid, after shearing with its opposing marginal ridge, continues upward and sagittally with its mesiobucco-occlusal angle on the distal of the triangular ridge of the buccal cusp of the maxillary first bicuspid, and with the mesial of its cuspal eminence gliding on the distal marginal ridge of the maxillary first bicuspid, passes the distobuccal supplemental ridges, with which it shears secondarily, and comes to rest against the distolingual supplemental ridge of the maxillary first bicuspid.

Occasionally, the maxillary cuspid has a distobuccal supplemental ridge whose occlusion with the buccal marginal ridge of the mandibular first bicuspid is similar to that of the mandibular second bicuspid just described.

The buccal half of the mesial marginal ridge of the mandibular first molar, functionally a long narrow cusp, may have definite incisal contact mesially with the triangular ridge of the buccal cusp of the maxillary second bicuspid, but distally with the distobuccal supplemental ridge (often prominent) of the latter. In centric occlusion, the cuspal eminence of the buccal cusp of the maxillary second bicuspid may rest in a groove just anterior to the buccal ridge of the mesiobuccal cusp of the mandibular first molar. Near centric occlusion, the buccal marginal ridge of the distal half of the mesiobuccal cusp of the mandibular first molar shears with the supplemental ridge in the mesial marginal ridge of the maxillary first molar, slightly buccal and inferior to the contact point.

The mesiobuccal cusp of the maxillary first molar, striking, respectively, between the distobuccal and mesiobuccal areas of the mesiobuccal and distobuccal cusps of the mandibular first molar,

functions similarly to the buccal cusp of a first maxillary bicuspid, the buccal cusps of the former resembling united buccal cusps of smaller bicuspids. Its buccal marginal and supplemental ridges shear with the buccal marginal ridge of its two antagonists.

The buccal marginal ridge of the distobuccal cusp of the mandibular first molar, closing between the buccal cusps of the maxillary first molar, has the same shearing principles as that of the buccal cusp of the mandibular second bicuspid.

The marginal ridge of the mesial half of the distal cusp of the mandibular molar, in the beginning of the laterocentric stroke, shears with the distobuccal cusp of the maxillary first molar; thence, upward and sagittally along the distal of the triangular ridge of the same cusps. The distobuccoocclusal angle of the mandibular molar (the distal cutting edge of the distal cusp) glides upward and sagittally on the mesial of the buccal half of the distal marginal ridge of the maxillary first molar. Often, the distal cusp occludes in front of the triangular ridge of the distobuccal cusp of the maxillary first molar. When this happens, the distobuccal and the distal cusp function as one, and the buccal marginal ridge of the mesial half of the mesiobuccal cusp of the second mandibular molar then occludes in the distobuccal triangular groove of the maxillary first molar.

The buccal marginal ridges of the remaining mandibular molars have similar mechanical relations with their antagonists.

Importance of the Overjet.—The maxillary buccal cusps apparently should have considerable overjet in order to allow a greater laterocentric stroke of the teeth, thus giving maximum function to the maxillary buccal supplemental ridges and to the maxillary lingual cusps at or near centric occlusion.

Function of Lingual Cusps and Their Ridges.—The lingual marginal ridge of the mesial part of the lingual cusp of each maxillary bicuspid occludes distally to the triangular ridge of the buccal cusp of its mandibular fellow in a shearing manner. The point of the lingular cusp of each maxillary bicuspid closes into the distal fossa of its mandibular correspondent; hence, the summital portion of the lingual marginal ridge of the distal part of the lingual cusp of a maxillary bicuspid shears with the distal marginal ridge of its mandibular fellow. After considerable wear, the lingual cusp of the maxillary second bicuspid forms a fossa by blending the distal pit of the mandibular second bicuspid and the mesial one of the mandibular first molar. Then, the lingual marginal ridge of the distal part of the lingual cusp of the second maxillary bicuspid occludes with the triangular ridge of the mesiolingual cusp of the mandibular first molar. The lingual marginal ridge of the distal portion of the lingual cusp of the first maxillary bicuspid finally wears into shearing occlusion with the triangular ridge of the buccal cusp of the mandibular second bicuspid.

The mesiolingual cusp of the maxillary first molar in centric occlusion stands just lingually to the mandibular distobuccal cusp in centric occlusion, a relation made possible by the arc-alinement of the three buccal cusps of the mandibular molar. The triangular ridge of the former cusp shears distal to that of the latter. The lingual marginal ridge of the mesiolingual cusp of the maxillary first molar, in an

unworn denture, where the injet is great, cuts chiefly by shearing against the triangular and supplemental ridges of the mesiolingual and distolingual cusps of the mandibular molar. After considerable attrition, the lingual marginal ridge of the maxillary mesiolingual cusp shears at the beginning of the clench with the lingual marginal ridges of the two mandibular lingual cusps. When a fifth cusp is present on the mesiolingual cusp, it has no occlusion until attrition of all the other molar cusps allows it to meet the lingual marginal ridge of the mesiolingual and distolingual cusps of the mandibular first molar, between which it finally closes. A prominent lingual ridge of a mesiolingual maxillary molar cusp would glide between the supplemental ridges of the two mandibular molar lingual cusps. The cutting ridge of the distolingual cusp of the upper first molar cuts at first in the masticatory stroke past the triangular ridge of the mesiolingual cusp of the mandibular second molar, but near centric occlusion with the mesial marginal ridge of the latter.

A study of the minutiae of the occlusion of the second and third molars would show that their shearing relations are similar to those of the first molars. The second deciduous molars have similar occlusal function. Those of the first deciduous molars resemble those of the second bicuspids.

Practical Proof of Multiple Shearing.—Molars and bicuspids are adapted for multiple shearing, as can be demonstrated practically by allowing a young subject having normal occlusion to bite into a thin plate of wax, which, when transilluminated (Fig. 10), furnishes some proof. By making a positive photograph of such an impression

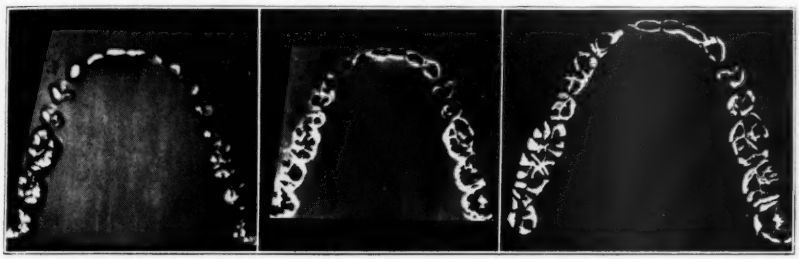

Fig. 10.—Left: Positive print of a transilluminated waxbite, dark areas showing comminuted pieces. Center: Negative print of a transilluminated waxbite, dark areas showing firmest bite-contacts. Right: Retouched and enlarged positive print.

(Fig. 10, left) the firm articular surfaces are recorded in light spots and the particles of food in the darker spots. With each closure of the jaws, a certain number of fine particles are made (Fig. 11). By cutting away the lighter spots of the positive and retouching the darker portions with India ink, a clearer photographic record of the comminuted pieces are made (Fig. 10, right).

By having the subject chew a piece of cocoanut meat once, then spitting it out and separating the pieces (Fig. 11), one sees that with the first closure as fine particles are made as the majority of those of a similar piece chewed a hundred times. By having the subject

chew twice, three times and so on up to ten times, on similar morsels, it is possible to see how rapidly they are comminuted, a rate that seems to be a polymultiple geometric progression. By using Christiansen's tritometric methods,[2] it is possible to measure the chewing efficiency of patients (Fig. 12) and to show how much more efficient the unworn is than the worn denture (Table 1).

By having a subject chew celery, the denture's method of pulpifying fibers can be shown (Fig. 13). The incisors are capable of cutting it into pieces. The bicuspids and molars crush off the succulent portions, cut the fibers into short segments, pulpify them and collect them into a bolus, from which the

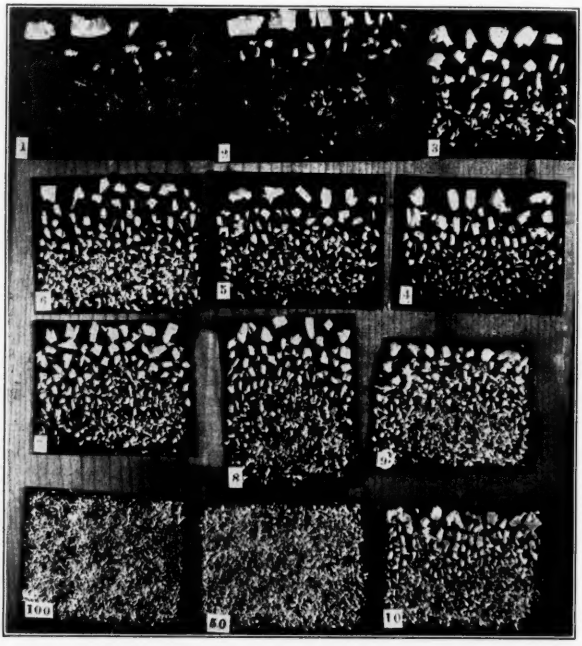

Fig. 11.—Pieces of cocoanut chewed by subject giving waxbite shown in Figure 10, the number of times pieces were chewed being indicated by numerals.

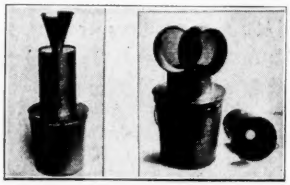

Fig. 12.—Series of sieves used to measure the fineness of comminuted particles.

2. Christiansen, E. G.: Einige Untersuchungen uber das Kauvermogen des Naturlichen und des Kunstlichen Gebisses, Vierteljahrsschr. f. Zahnheilk, 39: 1-17 (Aug.) 1923.

TABLE 1.—CHEWING EFFICIENCY OF PATIENTS HAVING NATURAL TEETH, WITH OCCLUSION GOOD.

	Sieve 1 Per Cent	Sieve 2 Per Cent	Sieve 3 Per Cent	Sieve 4 Per Cent
Young Man (Aged 23)	39.73	35.22	16.90	8.48
Older Men:				
Subject 1	53.95	35.00	7.85	3.27
Subject 2	80.92	11.39	5.69	1.90
Subject 3	80.90	12.40	5.70	1.90
Subject 4	89.59	8.69	1.19	0.18

nutritive substance is pressed, and, when well lubricated, the pulp is swallowed, and acts as normal peristaltic excitants.

Attrition of the Lingual Cusps of the Mandibular Molars.—The disto-lingual cusps of maxillary molars are the first to disappear. The buccal cusps of the mandibular are larger than the lingual but are used up first by wearing, chiefly against the maxillary lingual cusps, which are longer and larger in the beginning than the maxillary buccal cusps individually, save the distolingual maxillary cusps, which are occasionally wanting in the second and third molars. As the mandibular buccal and maxillary lingual cusps gradually disappear, the mandibular lingual cusps assume greater masticatory function, apparently a natural, prepared compensation for other lost cusps. After much wear, only remnants of the maxillary buccal and

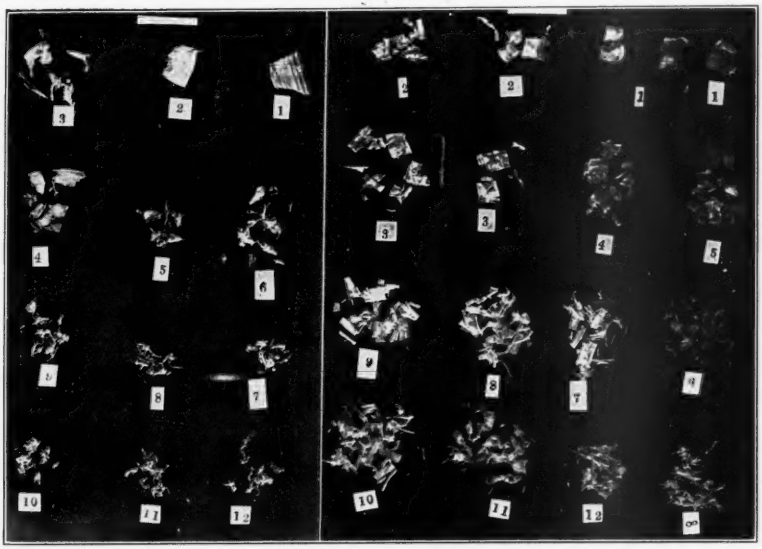

Fig. 13.—Effect of chewing, on celery (left); on asparagus (right).

mandibular lingual cusps present, and the old person crunches, slobbers and drools while eating for, as he bites, the food particles slip from between the smooth occlusal surfaces, sometimes even squirting out of the mouth.

Grit and Mastication.—It may be claimed that teeth will not wear unless the food is gritty and that the grit in the food, as stones in a gizzard, will partly compensate for the loss of the shearing ridges; but teeth will wear despite great care to provide gritless food and to prevent grinding habits, and it may be shown experimentally that grit does not facilitate chewing very much, if at all. The deciduous teeth, even when in fairly normal occlusion, often wear much before the age of 7.

Balanced Occlusion.—Is balanced occlusion a requirement of the natural normal denture, as in the artificial, or is it a sign of too much wear or of malocclusion? It occurs in both deciduous and adult dentures, though it is often wanting in fairly normal mouths. Does it occur in the Ruminantia and all or any of the Primates? It is not strange that the movements of the pendulous mandible are finally registered in the surfaces of the teeth through attrition or the settling of teeth into an equilibrium undisturbed by pathologic change or by improper external or internal forces? Is balanced occlusion necessary for maximum efficiency in natural dentures? Christiansen (Table 2) seems to have found that it is necessary for the highest chewing efficiency in plate dentures. No doubt, the movements of the mandible should be freed laterally by it in all extensive restorative dentistry, but perhaps this will be possible by other means now undiscovered. If balanced occlusion is a characteristic of the normal denture, we shall need to describe the function of the occlusal surfaces on the balancing side. These are unsolved problems,

TABLE 2.—CHEWING EFFICIENCY OF SEVERAL PATIENTS FOR WHOM TWO FULL PLATE DENTURES WERE MADE, ONE HAVING ONLY OCCLUSION (O), THE SECOND HAVING CORRECT ARTICULATION (A).*

		Sieve 1 Per Cent	Sieve 2 Per Cent	Sieve 3 Per Cent	Sieve 4 Per Cent
Case 1	O	70.096	24.808	4.519	0.577
	A	55.777	35.359	6.872	1.992
Case 2	O	84.685	13.674	1.516	0.152
	A	75.453	20.057	3.342	1.146
Case 3	O	88.083	9.400	1.999	0.518
	A	65.104	27.604	6.250	1.042
Case 4	O	67.080	27.057	5.299	0.564
	A	17.390	66.667	13.044	2.899
Case 5	O	54.973	39.268	5.236	0.523
	A	25.079	59.561	12.540	2.820
Case 6	O	89.172	8.280	1.910	0.638
	A	84.842	10.180	3.169	1.809
Case 7	O	86.613	11.156	1.623	0.608
	A	43.478	48.309	6.039	2.174

*From Christiansen, E. G.: Vierteljahrsschrift f. Zahnheilk. 39: (Aug.) 1923.

the greatest now being considered in dentistry, because, on their determinations, depends advancement of technical and preventive dentistry.

FUNCTION OF OCCLUSAL SURFACES IN OCCLUSION-MAINTENANCE

Possible Overemphasis.—A certain advantage is gained in the formation of occlusion by the teeth having long cusps and deep fossae at eruption, for a considerable variation from normal positions is allowable without predetermining malocclusion. The length of the mesiolingual cusp of the maxillary first molar, for instance, may allow it and its opponent a considerable latitude for misplacement, and, as eruption progresses, their occlusion will improve, if the point of the cusp lands within the rim of the fossa of its opponent.

The equilibrium of eruption, apparently, depends on the contact of the occlusal surface with its opponents, or, abnormally, with the tongue, cheek or some external object, held habitually between the teeth. Even here, the eruptive pressures of the opposing teeth mutually counterbalance each other.

The interdigitation of the cusps of teeth aid in keeping them properly located, although its importance has been greatly overrated, I believe, because relatively long cusps will not maintain the positions of teeth in cases treated by orthodontists, who have learned the importance of a rather long period of mechanical retention, after which, many times, relapses will ensue. Also, teeth deeply locked by malocclusion are freed by delicate forces. Furthermore, in developing malocclusion, habit forces will move teeth singly from locked positions, even when the subject practices chewing exercises.

Etiologic Considerations Necessary.—I hope, therefore, that those prosthodontists who now have so much faith in the power, beauty, efficiency and therapy of occlusion and so much enthusiasm to establish it will not err in overrating the purely passive power of cusps in occlusion-maintenance, a mistake of earlier orthodontists. They, too, must discover the etiologic factors of malocclusion and remove them as far as possible, if they wish to have better prognoses. In the past, when orthodontic efforts failed, many, instead of assuming that etiologic factors still prevailed, have believed that their relapses were due to their inability to establish accurate enough cuspal, apical and axial relations of the teeth.

Skill Versus Judgment.—Recently, Leon Williams[3] ventured the opinion that orthodontic failures could be avoided by placing the occlusal surfaces of the teeth in spherical occlusion and with the curve of Spee in perfect harmony with the condylar movements. Some dentists regard etiologic factors as of no importance, claiming that dentures are wrecked by their own malmechanics, and they believe that prosthodontia will be advanced by merely developing technics that will assure accurate cusp and axial relations, locate the teeth in true skeletal relations and place the occlusal surfaces in spherical occlusion with the typical curve of Spee

3. Williams, J. L.: A Study of the Temporomandibular Joint with Special Reference to the Form and Action of the Masticating Surfaces of the Teeth. J.A.D.A., 8: 290 (April) 1921.

in exact harmony with the condylar movements. But, it seems that, if the external and internal factors of life fail to produce normal occlusion, then, that made by interference will not long persist, if these same active factors prevail; for a mere change in the positions of the teeth will not necessarily change, obtain or maintain the balance of the prevailing forces, especially if some are variable and external.

Dentistry and orthodontia are one. The grief of each has common origin. What the child does, what it eats and how it grows influences occlusion throughout life. It is the aim of orthodontists to establish occlusion. Their grief has been great, but perhaps less than that to be experienced by the dentists who adopt the same aim in older patients. No doubt, it may be lessened by making skill obedient to judgment.

DISCUSSION

James Mark Prime, Omaha, Nebr.: It would be unprofitable to disagree with Dr. Stallard when he discusses the functions of teeth not having occlusal surfaces. While they do not have occlusal surfaces as described by Black, they play an important part in dental functions. When the teeth wear down, the mandible moves forward and upward, gradually closing the bite, until an end-to-end relation of the incisor and cuspid teeth is established. Uninformed persons have referred to them as "double teeth all round." When this condition becomes well advanced, these teeth do acquire real functioning occlusal surfaces. It is interesting to observe the experiments wherein Dr. Stallard demonstrates them to be more efficient, with certain fibrous substances, than are the molars. It is assuredly of importance to observe occlusal surfaces other than those of the bicuspids and molars that contact with teeth of the opposing jaw when the mouth is closed. A bicuspid or molar could lie on either side of the arch and be entirely out of occlusion, yet it certainly would not lose its occlusal surface simply because this surface does not function. In descriptive anatomy, we may speak of the occlusal surface of a bicuspid or molar as that lying within the marginal ridge. But when we see them in action, we observe occlusal surfaces of maxillary teeth meeting buccal surfaces of mandibular teeth; also, occlusal surfaces of mandibular teeth meeting and functioning with lingual surfaces of maxillary teeth. I like the word "sculpture" as used by Dr. Stallard and applied to the occlusal surfaces of the teeth. It is very important that the operator who undertakes to reproduce this sculpturing give thoughtful attention to Nature's purpose; otherwise, he will find himself "Nature faking" these organs by faulty reproduction or, what is perhaps worse, oversculpturing or carving. Much harm is being done to the paradontium by over-zealous carving of these surfaces, resulting in cusps too pointed, making incline planes instead of the natural curved or convex surfaces, occlusal surfaces entirely too wide, fossae too deep and marginal ridges too high and sharp, carving normal occlusal surfaces on teeth in badly worn dentures, etc. The use of the hard golds further contributes to more detrimental results. The lips, cheeks and tongue rearrange the food between the occlusal surfaces many times with each mouthful. Each clench represents a force ranging from 50 to 300 pounds, varying in different individuals. The closures run into the hundreds with each meal. In each clench, the food must escape from off these occlusal surfaces. Nature has very cunningly provided for this in the sculpturing of these surfaces. On each tooth, we find two or more avenues of escape. We could think of them as gateways, only the gates are never closed (except by unthinking operators). Those escapement places, breaking the mesial and distal marginal ridges, can well be likened to spillways of a dam. To aid in this, Nature has given us the embrasures between the teeth into which these spillways empty. When occlusal carving is not in accordance with Nature's plan, thereby closing up these gateways, traps are formed from which the food cannot escape. Teeth become lame and, if this is not corrected, are soon lost. Human teeth

carry a significant biologic imprint. Their characteristics are the result of eating, for untold ages, the flesh of animals, vegetables, roots and grains. They are a striking composite of the teeth of the carnivora and the herbivora. Man's masticating apparatus can be likened to a cider mill, in that it shreds grinds and presses. The incisors and cuspids cut, bicuspids shred and the molars grind. The lips, cheeks and tongue press the juices out. There are no flat surfaces on unworn teeth. When the occlusal surfaces are brought together, they simply make occlusal contacts at many small points. Many of these are marble-like, being comparable in form to the proximal contacts. I do not know when nor from whom the term "incline plane" came. It brought with it gross misunderstanding of ideal tooth form and has led to extreme distortions, with mischievous results. Webster's "New International Dictionary" defines an incline plane as a plane that makes an oblique angle with the plane of the horizon. It is not therefore, comparable with any part of the occlusal surfaces of the teeth. All of these natural tooth surfaces are convex, most of them highly so. In normal occlusion and before attrition has modified these surfaces, the masticatory apparatus is at its highest possible efficiency. Escapements are complete. No traps are possible, for on all sides and in all directions from the occlusal contact points, food particles may freely go. Friction created by the scouring effect of these excursions should, if the food is of the proper character, keep the teeth "as clean as a hound's tooth." As these occlusal contact points are worn by use, and what is, at first, a small facet in time becomes a flattened surface, year by year escapement becomes more and more difficult. Leverages begin to multiply on the paradontium. The condition is further augmented by the gradual closing of the bite and the shifting of the mandible forward and upward. Dental inharmony increases, while the mandible becomes more and more incongruent with its fixed antagonist. One of the outstanding characteristics of the occlusal surfaces lies in the remarkable manner in which Nature has constricted them. As an example, take a first molar, either upper or lower. With a Boley gage, measure its buccolingual diameter from marginal ridge to marginal ridge. Now, compare this with its diameter through its greatest thickness, buccolingually. It will be found that its occlusal surface is only about one-half that of the greatest buccolingual measurement. We find this almost constant in the bicuspid and molar teeth. The wedge-shape facilitates their eruption through the fibrous tissues. Being pointed, they draw less heavily on the musculature, as they are driven into and through the bolus. This form provides for a better prophylactic effect from the excursions, starts the excursions in a line to deflect them off the gingival tissues, greatly reduces the leverages to the paradontium, provides a safe-guard against fracture, reduces the surfaces on which trapping, under certain conditions, is made possible and prevents pinching the tongue and buccal tissues between the occlusal surfaces. This diminution of the masticatory surfaces makes necessary more clenches, in order to secure sufficient shredding and grinding before swallowing, and thereby, better insalivation. In the reproduction of the crowns of teeth either in part or whole, dentists have not given sufficient thought to the natural organs that they are attempting to reproduce. They have placed fillings, crowns and bridges with cruel neglect to occlusal accuracy and relations. Let us turn our eyes back to Nature and let her lead us out of some of these problems. Let us study her sculpturing. Let us test our restorations by taking accurate impressions of them, and carefully make models from these impressions, to see if we can detect our work in the plaster models. If our work has been well done, we shall be unable to discover our operations where whole or parts of crowns have been restored. Let us watch every piece for weeks, if possible, and see if our occlusal relations are correct. Much injury is being done because dentists are not doing this. Occlusion is the problem of the prosthetist. It is the prosthodontist's. It is ours. Too many times, skill has not been subservient to judgment. Let us not give all credit to mechanics if we succeed; nor lay all the blame at the door of mechanics, if we fail.

Rodrigues Ottolengui, New York City: A patient comes to the dentist for artificial dentures mainly because he wishes to chew

his food. If he cannot chew with his dentures, he is apt to dispute his bill. Hence, in articulating teeth the dentist soon learned that we must so arrange them as to supply the patient with an occlusion that would be efficient. With this thought of occlusion in mind, he came to have the slovenly idea that articulation and occlusion are synonymous. This has occasioned so much confusion that it is high time that we adopt standard meanings for our terms and adhere to them. In passing, let us call attention to the fact that even the early dentist sought to obtain, with artificial teeth, an occlusion that would be efficient. When he did this, or rather when he obtained the highest efficiency possible, he produced a functional occlusion, as far as the term applies to prosthodontia. Nor would this at all be synonymous with normal occlusion. There are two senses in which the word articulation is applicable to the natural teeth. Articulation of the teeth means the jointure of the teeth with their alveolar sockets. Every other joint in the cranium is an articulation; why not those of the teeth? Secondly, there is articulation with the teeth, as in the pronounciation of words. In both senses, articulation refers to function by, or with, the teeth. What is more important, functional occlusion includes both of these functions. Dr. Stallard appears to have adopted the idea that the principle, if not the sole function of the teeth, or of the occlusal surfaces thereof, is to chew food. We must admit that the chewing or mastication of food is one of the important purposes of the occlusal surfaces of teeth. Their very form indicates this. But the mere chewing of food is but a part of the function of the teeth, or if we must be more restrictive in our choice of language, of the occlusal surfaces of the teeth; for instance, food may be chewed sufficiently so that it may be swallowed, but unless it is chewed sufficiently, so that the digestive organs will be called on to do a minimum of work in order to digest this chewed food, the occlusal surfaces may have carried out their purpose to a certain extent, but they have not functioned. Correlation between the organs of mastication and the organs of digestion is impaired in exact proportion to the derangement from functional occlusion that may be present. We have considered functional occlusion only in its relation to mastication. But we must not overlook the fact that function means action and reaction between adjacent parts. There can be no doubt whatever that a most important integer in the function of occlusion is the influences of masticatory stress primarily on the pericementum, and, secondarily, on all the environmental tissues. In pathology, there is what is known as a viscious circle. The opposite of a vicious circle, let us say, would be a virtuous circle. The former is pathologic, the latter physiologic. An organ or part is functioning normally. Its actions toward, and its reactions with, adjacent and distant tissues aid them in accomplishing their normal functions. This coordination of function between the organs and parts establishes nutrition; nutrition transmitted to the original organ or part regenerates and vitalizes it so that it continues to function normally; a virtuous circle, which, when complete throughout the entire body, assures the individual of perfect health. Let us now apply these principles to the teeth. The occlusal surfaces of the teeth are admirably fashioned to perform the function of mastication. In and during the course of mastication, the muscles that open and close the jaws transmit stresses through the occlusal ends of the teeth so that the food is comminuted; but, at the same time, stress is transmitted through the apical ends of the teeth. This is true, because all force tends to express itself in two directions. This fact is well known to the experienced orthodontist, who must counteract this tendency or force, when he wishes his force to operate in one direction only, or in one direction more than another. That masticatory stresses are proportionately transmitted through the tooth root to its socket is an essential feature of the masticatory function, and here we may describe a virtuous circle. The normal functioning of the jaw muscles properly move the mandible about during mastication, exerting force in proportion to the resistance of the food to be crushed. Secondly, the normal functioning of the occlusal surfaces comminutes the food to such an extent that the digestive organs may function normally in extracting nutriment from the food supply. Thus, nutrition is transmitted back to the muscles of the jaw, replacing the tissue waste which results from use, restoring the muscles

to vigor, and thus enabling them to continue to function. It should ever be remembered that all use of human tissue means destruction of tissue, which must be replaced through nutritive processes. This is just as true of the bones as of the soft tissues. The use of the teeth during mastication, therefore, must produce a loss of bone tissue in the alveolus, which will be exactly proportionate to this use. The pericementum exists about a tooth root for the double purpose of acting as a cushion during excessive stresses, and to serve as a viaduct for blood vessels and nerves, which, when in proper function, act on and react with the tooth on one side and the alveolar bone on the other. Here, indeed, we have a local virtuous circle, the bone sustaining and supporting the pericementum, the pericementum carrying nourishment to both bone and tooth, and the tooth, by its pumping action, forcing the blood vessels and the nerves of the pericementum to function normally by nourishing and vitalizing the alveolus and itself—a beautiful example of reciprocal function. And this functioning of the pericementum is very largely controlled by the actions of the teeth during mastication. This is exceedingly important, and is readily shown. There are three sorts of use that may be made of the teeth: normal use, or function; abuse, or function plus, and disuse, or function minus. In one example of abuse, well known to the periodontist, and through him to the profession as a whole, the occlusal surfaces have been so altered by abrasion, or by improperly formed inlays or fillings, that functional occlusion becomes impossible, and excessive use results. This produces what is now called traumatic occlusion. Traumatic occlusion always means abuse, and the result is almost invariably disease of the pericementum. Traumatic occlusion is nothing but abuse of the masticatory functions of the teeth, causing function plus, and consequently producing disease, through inability of the pericementum to function properly. Appositely, disuse by retarding, reducing or preventing the normal stimulation that the pericementum should receive during the function of mastication, necessarily results in a loss of tissue without replacement, with a consequent atrophic degeneration, if continued long enough. Thus, overuse, or abuse, of the teeth during mastication, produces function plus, overstimulates the adjacent parts, and presently results in disease of the pericementum, with overgrowth thereof, and both absorption and hyperplasia of the bone; also not infrequently hypertrophy of the gum tissue. Conversely, a shortened tooth, resulting in lack of use, proportionate disuse, gives us function minus, which, if continued long enough, causes lack of normal stimulation, begetting tissue and bone destruction without repair, and finally atrophy of both the pericementum and the alveolar bone, accompanied by gum recession. This condition is often revealed in radiograms of teeth in disuse because of loss by extraction of their occlusal antagonists. Does anyone pretend that normal occlusion ever was, or ever can be, produced in artificial dentures? On the contrary, functional occlusion, as a study of the definition will disclose, may be used for natural organs, or for artificial dentures, even though it be true that a functional occlusion of the natural teeth would differ from a functional occlusion of artificial dentures. A common factor in both, when applied to the same individual, would be that, in substituting artificial teeth for lost natural organs, their arrangement must be such that they will produce the highest efficiency during the same excursive movements of the mandible that the patient enjoyed with his natural organs. The arrangement of the teeth might materially differ. Regardless of any definition supplied by Dr. Angle, or any other writers, normal occlusion necessarily implies an occlusion that is in agreement with a norm. As no two things in Nature are identical, a norm is, to a limited extent, subject to variation, which would still be within the range of what would be normal. Variation has always been a perplexing problem with biologists. Variation, which is distinctive and readily separable from the norm, or type, is at first called an aberration. An aberration must be either unique, or at least of very infrequent, occurrence. When occurring with greater frequency, it is called a variation, and some biologists give names to such variations. Others withhold names, until the variation is so frequent, or so constant in character, that it may be called a race. A normal occlusion in human beings predicates a standard of occlusion, variable within definite limits. There is no doubt

whatever that such normal occlusion exists; it exists in the mind, if nowhere else. But men's minds differ, and hence the mental conceptions of normal occlusion differ. The theory that there is a normal occlusion, which must serve the orthodontist as a pattern, or, arrangement of the teeth, toward which he must aim when treating malocclusions, has been mischievous, because normal occlusion occurs so seldom that the majority of dentists have never seen it, and the dentist, be he orthodontist or prosthodontist, has difficulty in visualizing the pattern that he is asked to imitate.

Functional occlusion is something totally different in this respect. A thorough understanding of what functional occlusion means will necessarily aid the orthodontist, the prosthodontist, the periodontist and indeed the entire dental profession. "Functional occlusion is such contact of the teeth of both jaws as will provide the highest efficiency during the excursive movements of the mandible which are essential to the function of mastication, without producing trauma." This, perhaps is a proper enough wording for a definition, but, in reality, with a full conception of functional occlusion, the words "without producing trauma," might better be omitted. Attention may be called to the fact that the definition reads "essential to the function of mastication," and not "essential to mastication." Thus, it is evident that something more than chewing is included when we speak of the function of mastication. Functional occlusion differs from normal occlusion in this essential respect. Normal occlusion necessarily means a type of occlusion that, within certain variations, is theoretically common, or possible with all races of man. Functional occlusion on the contrary is a condition limited to an individual, and is never duplicated in any other individual. It is "such contact of the teeth of both jaws as will provide the highest efficiency," etc. Not such contact of the teeth of the jaws of all men, but such contact of the teeth of the individual man who is the patient to be treated. There are no two individuals identical in all their measurements. There are no two sets of human teeth that are identical. There are no two incisors, no two cuspids, no two bicuspids, no two molars which are identical, even in the mouth of an individual. Nevertheless, it must be true that any set of teeth, in any mouth, can be so arranged as to provide "the highest efficiency during all the excursive movements of the mandible which are essential to the function of mastication;" that is to say, to provide the highest efficiency possible with that particular set of teeth. And such arrangement would be functional occlusion for that individual, even though it might not be the highest type of functional occlusion. Thus it follows that, whereas normal occlusion is a theoretical occlusion common to mankind, functional occlusion is an efficient occlusion, never duplicated, but confined strictly to individual tooth forms, individual variations of tooth form and individual necessities. A full comprehension of functional occlusion will reveal the following important esoteric truth: Given a particular set of teeth, there is but one arrangement that may be made of them, that will constitute functional occlusion. There is but one position into which each tooth must be placed; there is but one relation of direction which each tooth must bear with its socket, and there is but one occlusal relation that each tooth must have with its antagonists, that will result in functional occlusion. Any departure from such posing of the teeth, even the slightest, will interfere with functional occlusion. The result may be, in a sense, an adequate occlusion, but nevertheless it will not be a functional occlusion; it will be functional occlusion, plus or minus. The inadequacy of the term normal occlusion has depended on the fact that it has been impossible for the orthodontist, let us say, to visualize normal occlusion for the malocclued teeth brought to him for treatment. As with the natural organs, there is but one position into which artificial teeth may be arranged in denture construction which will provide the highest efficiency during the function of mastication. Points of importance to be considered are: first, that the teeth must be so arranged that they will coördinate with the normal movements of the mandible. Here, we have a point often overlooked. The normal relation of the mandible to the maxilla may be obscured, if the jaws have been edentulous for some time, so that the patient has become habituated to a closure that is abnormally close. To provide dentures of a proper height at once may cause such tiring of the jaw muscles as to interfere with suc-

cessful use of even properly constructed dentures. The second consideration would be that, whereas in the natural organs the teeth function individually, in artificial dentures each set of teeth becomes a single unit. And this fact necessitates a compensating alteration of occlusal form and relations, as is well known to skilled prosthodontists. And it is this fact that renders the term normal occlusion useless to the prosthodontist. Suppose a patient enjoying normal occlusion. Extract all of his teeth and place these, his own teeth, on vulcanite bases. They cannot be made to function. Finally, the prosthodontist should remember that a part of the function of mastication is the preservation of the health of the tissues of the gum and bone. After the extraction of a tooth or teeth, it is probable that true function can never be fully restored; that a gradual resorption of these tissues is inevitable. Nevertheless a denture, whether full or partial, should always be so constructed that this integral part of masticatory function should be considered. The denture should not bear so hard as to cause function plus, with the result of abrasion followed by hypertrophy; nor should it bear so lightly as to cause function minus, with resultant atrophy. My meaning can be perhaps made clearer by considering partial denture work. If the base rests upon the gum without occlusal rests, the outcome must be function plus, during mastication, with resultant abrasion and hypertrophy of the gum and resorption of the bone if long continued. If occlusal rests are so constructed that no compression of the saddle area is provided during mastication, we get function minus, with resultant atrophy.

Dr. Stallard (*closing*): Nomenclature is no trivial matter, but terms are of no importance except as they are good vehicles of thought. In my short paper, encompassing the primary functions of the occlusal surfaces, I specifically state that they function in speech and mastication, and in developing and maintaining occlusion. In speech, we do use the occlusal surfaces, but we do not occlude the teeth while uttering articulated sounds. So, in a stricter sense, speech is not a function of occlusion. Indeed, occlusion, being an expression of function and not in itself a thing, organ, cell, or tissue, can have no function, for Dr. Ottolengui has well contended that "function is the normal action of an organ or part." Teeth exert a part of their function through the act of occluding and another part without occluding. This being true, how strangely it sounds to speak of "functional occlusion." I have not dwelt much on the specific function occlusal surfaces have in developing and maintaining occlusion, since that has been the chief topic of orthodontists for many years, and I believe that they have greatly exaggerated their importance in this function. Even Dr. Ottolengui confided that if orthodontists would only give teeth "functional occlusion," their results would tend to be more permanent. If "functional" or "balanced occlusions," or the factors calling them into being are as powerful as Dr. Ottolengui and the "balanced occlusionists believe, then why are these relationships so negligent that malocclusions are allowed to develop? Having been so negligent as to allow gross oral deformities to develop, does it not seem reasonable to suspect that they will also allow artificially established relations produced by treatment to relapse to original or worse conditions. I believe I have come infinitely closer to uncovering a few factors of malocclusion than these, my colleagues, but the more I study causes, the more hopeless my faith in empiric treatment grows, and the more certain the science of prevention appears.

It seems to me that committees on nomenclature must be bound by the meaning and usage of terms used by foreign and domestic investigators, regardless of faulty meanings of the roots comprising the terms or the misconceptions originally accompanying the same. Orthodontia, according to its derivations as compared with the present development of its aims, is a poor word, but why change? Rather let us retain it for its historical value. My task in this paper was to describe precisely, ridge by ridge, the normal articulation of teeth, and for this I cannot possibly use the term "functional occlusion," because I am describing a relationship, and I am more convinced than ever that this term is unfit for this very specific moving relation of the antagonizing occlusal surfaces since Dr. Ottolengui has overgeneralized it. I need not point out the lack of consistency of the claim that normal occlusion cannot be applied to artificial teeth,

but that "functional occlusion" can be, even after admitting that "function is the normal action of an organ or part." Now plate dentures are not parts or organs of the body, much less normal. Of course, the definition can be stretched by adding a minus sign or a plus sign to include everything, viz.: the individual normal, the ideal normal, the physiologic normal, etc. Does this not prove that the word is too general to apply to that specific relation between the antagonizing ridges of occlusal surfaces? It is objected that articulation should not be used for the antagonization of teeth, since it means something very definite in anatomic terminology. But this need not cause any discomfort, since in literature often a word may have a variety of different meanings. Articulation, whatever has been its historical meaning, in dentistry means the joining together of teeth to do work. Opposing teeth, when they meet so intimately in the various occlusal positions and glide on one another, simulate bones more than they do anything else. Their attritional facets resemble articular facets of bones more than anything else, and their masticatory excursions resemble articular excursions more than anything else, except perhaps the articulation of gears. Articulation is used in botanical science to describe jointed plants, those parts where separation is made easier. I was particularly anxious to have Dr. Prime's discussion focused on the mechanics of mastication, as regards the occlusal surfaces, but I am disappointed that he did not attack the relationship of shearing blades, which I have assumed are normal. The question in this work for us to settle is, "What are the normal elements of articulation?" Once our concepts of the minute elements of articulation are settled then we shall no longer as a profession indulge in broad philosophic discussions as to what constitutes "normal" or "functional" occlusion. Apparently, we are too careful about the name of our vehicles and not enough interested in what we are carrying in these vehicles. Let us find out what are the best relations the opposing occlusal surfaces can have and produce these in orthodontic work or artificial denture constructions. I suspect that Dr. Prime is not so much opposed to sharply sculptured restorations as he is to the faulty articulation often given to such. I presume that malarticulated sharp ridges and deep sulci, being positive in their relationships, demand greater accuracy in restoration, and I am sure that the man who tries to give to his patient good occlusal surfaces better be as careful to give them splendid accurate articulation. He who wants to give inlays and crowns good natural occlusal forms better learn how to restore them carefully on accurate articulators for which exacting technics have been formulated. For the man who does all his work in the mouth, independent of an articulator, needs to give his patient dull functionless occlusal surfaces, since he cannot otherwise give them accurate articulation. Give incising ridges proper articulation and form and I believe the escapement of food will care for itself. I am wondering how Dr. Prime ever became so interested in food escapements instead of comminution. He seems to be laboring under the belief that foods should readily slip from between the teeth. It seems to me that the sculpture of the occlusal surfaces should hold the food so as to cut it into fine particles. Just study a worn out denture during mastication to see how easily food escapes.

ORTHODONTICS AND GENERAL DENTISTRY*

By HUGH GRUN TANZEY, D.D.S., Kansas City, Missouri

FOR more than two centuries, recognized authorities in the dental profession have been particularly interested in orthodontia. These pioneers, as a rule, were recognized in the vanguard of practically all other branches of dentistry. It was before the heyday of specialists, but outstanding members of the profession were especially good in most anything they undertook. While all dentistry has been advancing, it must be obvious to the casual observer that orthodontia has been unusually favored; not only because of the type of dentists who have strayed into her fields, but also because of their indefatigable efforts to develop the subject or exhaust the fund of knowledge pertaining to it. As a consequence, they have succeeded in convincing all college heads that this department should receive more encouragement. Nearly all district, state and national dental societies have added orthodontia sections to their programs. Dental and medical journals are devoting more columns to its literature. Orthodontia directories, societies and postgraduate schools have been established for the purpose of advancing the science.

Among other questions of mutual interest to the general practitioners of dentistry and the orthodontist is one which stands out as vastly more prominent and which has attracted far greater universal interest. "What is the shortest possible time required to treat successfully a case of orthodontia?" The question is attended with a kind of accepted belief that some standard type of appliance should be universally adopted that would meet the demand. (Naturally, some appliance that could be wound up and set for the particular job before it leaves the factory would be much preferred.) Only an admitted few are struggling with the big question "How shall we prevent cases of malocclusion?" and only a few more are concerned about intercepting the progress of malocclusion early. Two outstanding methods have been employed at one time or another by nearly everyone who has attempted orthodontic treatment. Both have been universally condemned by the reliable orthodontists. One plan was to extract the crooked tooth, allowing its neighbors to migrate at leisure, hoping that the spaces caused by extraction would eventually close and the crooked tooth incident would be forgotten and the operator forgiven. Another plan that, if not a distinct indication of enterprise, denotes a bit more toleration was to place an apparatus of some sort on the offending tooth, which was invariably one of the six anterior teeth. This apparatus was so carefully

*Read before the Section on Operative Dentistry, Materia Medica and Therapeutics at the Sixty-Seventh Annual Session of the American Dental Association, Louisville, Ky., Sept., 24, 1925.

designed as to be not only a work of art but also of such a comprehensive nature as to reduce embarrassment and discomfort to the wearer of the adornment to a minimum. The fixture rarely extended back of the cuspids, where mastication would be interfered with, or where the real trouble usually lay. This appliance might be a shell crown with locks, levers and spring attachments, or it might be just a plain stovepipe collar with accessories, but whatever it did accomplish in the way of crowding other teeth out of the "line of occlusion," etc., was considered highly commendable.

In the great centers of population, where there are a few orthodontists, and hundreds of dentists, there are thousands of children with malocclusion of the teeth. It is to be regretted that children reared in homes of affluence and culture, are often less enlightened on the subject, and their teeth neglected to a greater degree than is the case with children apparently less fortunately situated. This may be due to one of two influences: 1. The general practitioner feels reluctant to refer his wealthy patient because he seems to feel that he is losing the large fee which the specialist is sure to get. In many instances, these patients visit the orthodontist of a friend or acquaintance, learn about the condition of their teeth and wonder why their dentist had not long since warned them. In these cases the orthodontist is apt to express his opinion plainly, and the patients, feeling that they have been neglected, look for another family dentist. 2. The orthodontist, being of a more or less retiring disposition, prefers to work with the clinic patient and those in moderate financial circumstances, where he has cooperation, than to waste his efforts on the wealthy who care more about other things and grumble about paying for his services.

It is gratifying to know that it is the exception rather than the rule to find general practitioners attempting to correct typical cases of malocclusion. On the other hand, according to the best advices obtainable, when the dentist does essay to take charge of a given case, he usually selects what he chooses to call an easy and simple case (one that an adept orthodontist would probably pronounce a well-defined case, if not a plainly difficult one) and he lights on some keen idea of short cut route, and employs methods that are obsolete, or perhaps an appliance the good qualities of which has been extolled in advertisements. Many times, an experienced orthodontist would hesitate to assume the responsibility of managing such an appliance, and, not infrequently, he would condemn it without ceremony.

Sometimes, we are informed that a dentist will take the cases of some of his choice patients, preferring to take a chance on failing to the other alternate of allowing the family to get into the hands of the dentist across the way, who may be treating a few cases, presumably those paying good fees.

Among the general practitioners are those dentists who refer all children to the orthodontist for examination and for subsequent treatment, if in his opinion it is found advisable. This dentist does not care to take any chances with the children of his friends.

There are those dentists who treat a few carefully selected cases successfully; there are those who take the short routes employing questionable appliances; and then there are those dentists who do not observe early symptoms of

malocclusion, or who refuse to be convinced that treatment should be started until every chance has been given the jaws and teeth to develop normally, or until a well defined case of malocclusion has unquestionably been established. I have suspected that there are those among the species who believe they can take the most dilapidated adult mouth and build it up with comparative ease and accuracy. Then why orthodontia?

Fig. 1.—Left: A case of mesioclusion, the result of mutilation through the loss of the right mandibular first permanent molar, the result of caries, in a patient, aged 7 years. Right: Appearance after three years' treatment. Figures 1-3 illustrate Case 1.

It has been our contention for years that little, if any, harm would be done the individual in any ordinary case under treatment for a few months (and that length of time will usually more than satisfy the operator). The real damage is done years after, when the dissatisfied patient sounds a warning to all concerned stating he has been a victim, although "treated by the very best dentist in the country."

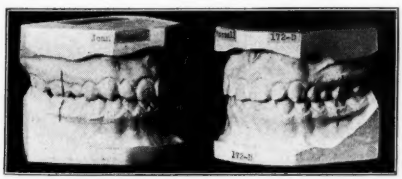

Fig. 2.—Appearance of case shown in Figure 1, after seven years' treatment, showing the second right mandibular molar approximately in the place of the first molar and the third molar, erupted at the age of 14, in fair occlusion with the maxillary second molar.

Any or all of these recited objections could be overlooked if we were called on to exercise our forgiving dispositions. But aside from urging the general practitioners, now in the smaller cities and towns, to prepare themselves for treating orthodontic cases while short term courses are available, and before prohibitive laws are enacted, I wanted es-

Fig. 3.—Appearance of the right mandibular molar region of the case shown in Figures 1 and 2, after treatment, indicating that the left first molar should have been extracted and the space closed. The pulp died subsequent to treatment, under a large amalgam filling.

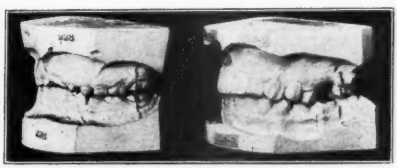

Fig. 4.—Appearance of case before (left) and after (right) seven years' treatment, started at the age of 7 years. The upper left lateral incisor and the first bicuspid were forced out of alinement by the third molar. The roentgen ray revealed the absence of the mandibular third molars. The maxillary first molars were extracted. (Caries and fillings in these teeth were sufficient evidence to condemn them, instead of the second molars.) Figures 4-6 illustrate Case 2.

pecially to call your attention to the possibilities of orthodontic treatment, where loss of permanent teeth by extractions or otherwise has been found necessary. (Figs. 1-2.)

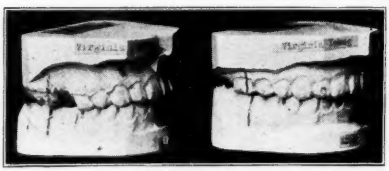

Fig. 5.—Case shown in Figure 4. Left: Appearance after extraction of the maxillary first permanent molars. Right: Appearance after one year additional treatment required to close the spaces.

The liberal use of the roentgen ray frequently reveals conditions otherwise unsuspected, especially as regards the absence or presence of third molars or lateral incisors or any other teeth in question, and their position, etc. (Fig. 3.)

The first permanent molars probably more frequently fall victims to caries, and are subsequently lost. This usually happens at about from 7 to 10

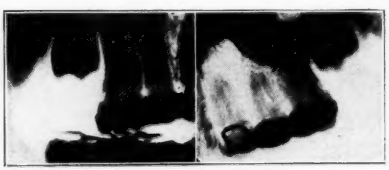

Fig. 6.—Position of roots of teeth (case shown in Figures 4 and 5) after spaces have been closed.

years of age. While not advocating the carelessness which permits the decay and loss of these or any other teeth, I believe that in many of these cases it is advisable to extract the other first molar in the same jaw and, in some instances, we would be justified in sacrificing teeth in the opposing jaw in order to compensate. (Fig. 4.)

Fig. 7.—Maxillary left cuspid impacted and right second molar tipping over a remnant of the first molar root, in a patient, aged 15 years. Figures 7-8 illustrate Case 3.

Naturally, it would follow that we must be prepared to assist Nature in closing the spaces caused by the loss of the doomed teeth (Fig. 5), and likewise we should ascertain at the earliest possible date (by means of the roentgen ray) just what teeth we are to guide into position, and at what time we are to expect them and where. (Fig. 6.)

Extensive crowding of anterior teeth attributed to impacted third molars may be easily adjusted after extracting the

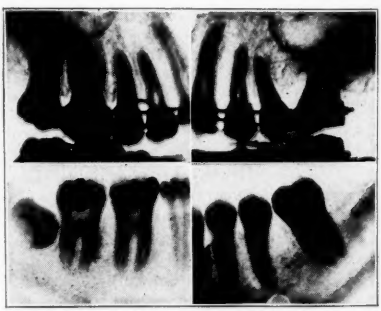

Fig. 8.—Impacted cuspid (case shown in Figure 7) in normal position after ten months' treatment. The spaces in the right molar regions are nearly closed. The case is still under treatment.

second molars, or it may be advisable to remove the first molar or a bicuspid because of caries. It is advisable to begin closing the spaces immediately after extraction, when possible. In no instance should the teeth be allowed to drift following extractions, with the expectation that they will assume desirable positions. They must be controlled and made to go where they should go. Impacted cuspids and the congenital absence of lateral incisors cause about as intense anxiety as almost any other anomalies with which we have to contend. When recognized early, they can be handled very nicely. (Figs. 7-8.)

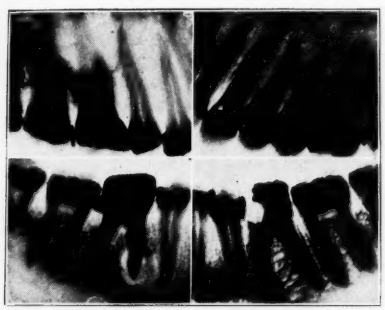

Fig. 9.—Mandibular area at the apex of the anterior root of the mandibular left first permanent molar. The right molar crown is nearly gone, and the anterior teeth are crowded. Figures 9-10 illustrate Case 4.

Not infrequently tipping of the molars and bicuspids is present after the loss of teeth. Often these teeth can be straightened, the arch form and relationship restored and the bite corrected, and a beautiful restoration, constructed by the general practitioner, may be installed, to the gratification of all concerned. We are dealing with the most valuable possessions of mankind, and I believe that a dentist is no more justified in placing an extensive and expensive piece of bridgework on tipping crooked teeth for abutments, cutting across corners, etc., than a highway or railway engineer would be in constructing hard surface roads and bridges over calf trails and crossings. (Figs. 9-10.)

Our greatest hope lies in the young dentist. We must teach him to fill the teeth of 4 and 5 year old children with inlays and alloys. He must know foods and their values. He must undertake the difficult tasks. Orthodontists have long since abandoned hope that older dentists would ever do much in the way of constructive dentistry with children. It must be taught the young man in the colleges.

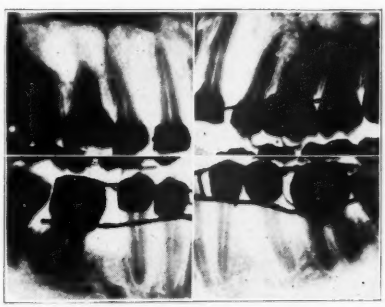

Fig. 10.—Case shown in Figure 9, after one year's treatment, following extraction of the mandibular first molars and maxillary first bicuspids. The spaces are almost closed and there is little tipping. The case is still under treatment.

DISCUSSION

James H. Ferguson, Jr., Baltimore, Md.: There is no specialized field within the confines of dentistry that has made more scientific progress than orthodontia during the last fifteen years. It is to such men as Angle, McCoy, Tanzey, Dewey, J. Lowe Young and others that credit must be given for placing this specialty of dentistry beyond the realm of exploitation. There are perhaps more

graduate schools of orthodontia than of any other branch of our profession, which augers well for the vision and progressiveness of the men who are willing to give the benefit of their knowledge and experience to those who are giving up general practice to engage in this work. In his paper, Dr. Tanzey calls our attention to the fact that only an admitted few are struggling with the question of how to prevent malocclusion. This, to my mind, not only casts a reflection on those in general practice, but the responsibility also lies, and even more heavily, upon the shoulders of the orthodontist, and especially those who are teaching the dental student. Unfortunately, the heads of many of the dental schools are not allowing a sufficient number of hours per week for instruction in the orthodontic department. The majority of the schools are limiting their clinical instruction to one or two afternoons a week. It does not take a man with teaching experience to realize that it is impossible to cover thoroughly the clinical aspect of orthodontia with clinical instruction so limited. Perhaps the adding of the predental year and the ultimate changing of some of the academic subjects from the dental curriculum will result in more time being spent in research to determine the etiology and prevention of malocclusion because orthodontia unquestionably embraces within its sphere much more than the art of correction of malposition of the teeth. Diagnostic considerations have assumed such importance as to foster and demand a broader conception of its scope and a deeper insight into the normal and abnormal conditions of growth of the maxillary arches and the adjacent structures. Although manifested locally, malocclusion is frequently associated with such symptoms of constitutional disorder as to demand the careful consideration of the history, the health and habits of the patient in order to establish correct lines of treatment based upon a knowledge of all subjective and objective symptoms of both local and general pathologic disturbance. The field of orthodontia is a broad one, requiring a clear conception of anatomy and the physiologic development of the dental arches and environmental structures, their pathologic manifestations and local or remote etiologic characteristics. It also embraces the field of facial orthopedia and has necessitated a closer study of the art relations of the face. It is interesting to watch the progress of a case, as the teeth are being forced into central occlusion and their normal functional activity is being restored; to see the entirely different facial expression and the marked esthetic improvement. I am not in accord with that part of Dr. Tanzey's paper in which he says that the general practitioner feels reluctant about referring his wealthy patients for orthodontic treatment because the orthodontist, rather than he himself will obtain the large fee. I give the general practitioner credit for better judgment and for being a better financier. Personally whenever I refer a wealthy patient to an orthodontist, periodontist or exodontist, I frequently call them and request that their maximum fee be asked of the patient. It only makes it easier for the general practitioner to demand a fee for his services that will compensate for those patients whose circumstances prohibit their paying the fee that we all have a right to demand of those who are well endowed with earthly riches. I am speaking generally and am not directing my remarks at any one class of specialists, but I know that I am expressing the sentiment of a great many of the thinking members of the profession when I say that if there were more coordination and a better understanding between the specialist and those in general practice, and less egotism on the part of a great many of the specialists, the ultimate result would be better cooperation and better service to the patient. Dr. Tanzey has called our attention to the fact that so many of us do not recognize the importance of having malocclusion corrected in the very beginning with our little patients. This is undoubtedly true, and we are not fair with the children, their parents and ourselves if we lead them to believe that the functional activity of the teeth will be restored as the arches develop, without orthodontic treatment. He has also called our attention to the importance of the roentgen-ray, and I feel that it is universally recognized that a complete radiographic examination is the only scientific means of predetermining conditions, since impactions and pathologic areas are often revealed that will necessarily have to be taken care of before orthodontic treatment is undertaken. Dr. Tanzey takes a somewhat radical view when he recommends the extraction of healthy teeth in the opposing jaw to compensate for the extraction of carious ones. It is more or less a contradiction of his just condemnation

of the extraction of the permanent teeth on the part of some men in general practice, in the hope that the space will be obliterated as the arch develops. I believe it is possible to restore approximately the normal functional activity of occlusal relationship of malposed teeth without resorting to the removal of teeth in the opposite jaw that are in their correct relationship to the adjacent ones. I feel, as Dr. Tanzey does, that it is not a good plan to make a bridge restoration, using teeth that are tipping as abutments. At least, a fixed bridge would be contraindicated. It would necessitate the cutting away of too much tooth structure, and, if normal occlusal balance were obtained in the restoration, the peridental membrane and environmental tissues would be put to the supreme test.

Harris W. McLain, Chicago, Ill.: The question as to what to do with his orthodontia cases is becoming a more serious question each year to the dentist. The public is demanding this service. Many far-sighted men in the profession have seen this and, as Dr. Tanzey has pointed out, have made efforts to solve the problem in various ways. Some have listened to the siren call of the appliance vendors, whose appeal is usually financial rather than professional. Of these, a number have awakened to the fact that orthodontia is more than mechanically arranging teeth in a more favorable or pleasing position in the dental arches. The training of the dentist, as well as his daily routine at the chair, has tended to make him do most of his thinking in terms of teeth and, frequently, to disregard the other structures making up and associated with the dental mechanism, which, as a whole, is, of all parts of the body, the most complicated in its growth and development. As far as orthodontia is concerned, the general practitioner has fallen far short of keeping up with the great progress that he has made in other branches of dentistry in the last decade. Unless the dentist approaches his orthodontia cases from the physiologic and anatomic as well as the mechanical standpoint, the majority of his efforts will ultimately fail. His cases must be carefully selected. If he would undertake no cases after the cuspids and second permanent molars have erupted, he would err less often in his selection. I cannot agree that mutilated cases in which teeth have been lost are often favorable cases for treatment. In my hands, these have always been a great problem, and results have sometimes not been gratifying. Neither can I endorse his suggestion that it is frequently good practice to extract teeth in the same or the opposite jaw to compensate for those already lost. Irreparable injury, rather than benefit, often results from this procedure. I believe that the big question in orthodontia, as Dr. Tanzey has said, is "How shall we prevent cases of malocclusion?" I believe that therein lies a big opportunity for service to his little patients on the part of the dentist. We know little for a certainty about the etiology of malocclusion, but the question of prevention can be answered only by the discovery and removal of causes which are active in producing the various types. In order to go about it intelligently, two things are necessary. The first is a full and complete understanding of the character, growth, development and function of the whole masticating mechanism. The second is a careful study of the child, his environment and his reactions to it, his habits, activities, diet and rest.

If the dentist is able to impress on the mother the importance of proper function of the jaws, lips, cheeks and tongue, so that she may recognize and forestall pernicious habits, he will be able to aid materially in preventing malocclusion. If he warns her of the deforming effects of external pressure, such as leaning on the hands and arms while sitting and of resting the face upon them or upon hard pillows during sleep, he will accomplish something. If he can make suggestions concerning diet that will be of benefit to the growing denture, these benefits will be reflected in the general health of the child. If he is unprepared to do these things, in addition to making proper restoration in both deciduous and permanent teeth, he should hesitate to undertake the mechanical correction of deformities of the jaws, of which irregular teeth are only symptoms. By this, I do not mean that the dentist should not attempt treatment of malocclusion but that he should undertake this work only when he is sure that he is prepared to carry it through. The possibilities for injury are greater in orthodontia than any other branch of dentistry, and success depends on a serious study both of the subject and of the case under consideration.

THE TEACHING OF ORAL HYGIENE AND PERIODONTIA TO DENTAL PRACTITIONERS*

By ROBIN ADAIR, B.S., M.D., D.D.S., Atlanta, Georgia

WHEN the Academy talks of teaching periodontia to the general practitioner of dentistry, it is certainly with no wish to criticize or dictate but to give accurate and constructive suggestions.

The members of this Academy have found that instead of oral hygiene and periodontia being a mere side line, it is the very foundation of the practice of dentistry. They believe that if general practitioners possessed a better understanding of the great truths of preventive dentistry, they would be more efficient in their practice, and this without any loss to themselves, but rather with the result that work would be lighter and the remuneration as great and certainly many thousands of teeth would be saved.

I am not accurately informed regarding or acquainted with some of the outside activities now being advertised for educating the general practitioner of dentistry in periodontia. I have had considerable experience in my own locality, and for this reason my remarks will be a recital of experiences, more or less personal, with the problem as I have encountered it.

In 1912, I received a call to establish a chair of preventive dentistry at the old Southern Dental College. This, I believe, was the first dental college in the United States to take this step. In this work, I encountered an attitude of indifference to this subject, and if, try as I might, at the end of the year I had enlisted the real interest of as many as ten students in each class, I felt pleased. This diffidence could not all be attributed to the inefficiency of the teacher, for when I branched off occasionally to some mechanical procedures, the class would at once become interested. Nor was this attitude confined to this college; for when, in later years, nearly all colleges were teaching the subject, I found that the same problem was confronting each professor.

In this connection, may I describe a rather unique method which proved valuable, and is mentioned here because some like method might be used by the graduate dentist with equal success in study club work.

The practical work, both of prophylaxis and periodontia, was done in the mouths of the dental students themselves. For prophylaxis, the class was divided into small sections. At the clinic hour, one section became patients while another like section acted as operators. They soon came to appreciate the fact that traumatizing of the gums, rough handling and defective work

*Read before the American Academy of Periodontology, Louisville, Ky., Sept. 17-19, 1925.

were matters of serious importance as was similar carelessness in the other branches. At the next clinic hour, the former patients became the operators and had the chance either to "get even" or do better work. It was my experience that infirmary patients treated for periodontoclasia returned irregularly or not at all, so we soon came to handle the periodontia cases just as we did the prophylaxis. Any student having pyorrhea could be a patient and was always on hand for observation and treatment.

Just before the final examination the following notice was posted—

TO THE SENIOR CLASS

Without further notice an examination of the mouths of the Senior Class is soon to be made and the mark given at this time will count on the final examination. Any one presenting an unclean or diseased mouth will not receive my name on his diploma.

It is safe to say that this class presented the best conditioned mouths. The history of this class also shows that more men were interested in this special branch and became lecturers or carried on the work in their general practice.

For the moment, let us follow the usual career of the young dentist: Probably, of all branches in college the least time was given to oral hygiene and periodontia; and in practice he soon finds out that these cases take lots of time and he is not getting good results. The detail man comes to his "relief," and he follows one or the other of these "sure cures," to no avail. His patient probably has told him that other dentists have treated the case or that it "could not be cured." He hears the same story from his casual dental friends. He soon finds it easy to say the same thing and further than painting the gums with iodin he "does not treat pyorrhea any more."

Not all dentists are willing to give up so easily: here is a dentist who wants more information and skill. At the conventions, he watches the clinics on periodontia. In the usual allotted time, and with the physical impossibility of showing this work at one sitting, before a crowd, they either get nothing or get wrongly some pet method of the clinician which they cannot carry out in practice. It has often been said that all periodontists are "nuts," and I often think the title is well earned when we see the way some of us conduct a clinic. I know I am one when I try to give a clinic on this subject before a large crowd.

Let us now suppose that five years has elapsed since graduation. The number of those who are interested in these subjects has lessened considerably. Perhaps, a few matriculate for a "summer course." May I ask this question of those who have taken these courses: Are they run for the money consideration or to exploit the peculiar views of the lecturer?

If these "summer courses," are satisfactory, the remainder of this paper need not be written or read. If you feel as I do, that something more is needed, let us proceed and classify some of the fine points needed for the work. If you will further pardon another personal reference, I shall relate what was the turning point in my periodontia education, believing that it will strike a like chord in many of your experiences.

All the education worth while that I have acquired since graduation has been received by visiting the offices of men prominent in this work. Well do I remember my visit to that enthusiastic founder of modern prophylaxis, Dr. D. D. Smith. He invited me to his

office in 1898 to see the practical results of his work. In those days, he had just a screen separating his chair from the reception room. As I entered, for the first time, I heard him tell the patient that he had a green youngster from Georgia coming to see his work. I heard the lady remonstrate that she did not care to, nor would she, have anybody else looking at her mouth. About this moment, Dr. Smith spied me and came out from behind his screen and said, "Come here, Dr. Adair. My patients do as I say, not as they want to."

We cannot all command as did Dr. Smith, but there are always many little practical points which we could demonstrate to the general practitioner. Dr. Smith carried this art far, and the result has been almost a new science.

Several years ago, my periodontia work was not satisfactory to me. I had seen about all the experts operate and had read all the papers, but still needed a personal touch of mutual interest. I decided if there was one sane man doing this work it must be Justin Towner of Memphis, Tenn. I decided to thrash my doubts out with him.

On that first day, he patiently discussed the many problems of periodontia which I had compiled and presented. In the next few days, I saw and learned some things of real educational value.

An opportunity soon presented itself to help my fellow practitioners, many of whom I found were wanting this knowledge; but we could not close up our offices and go to some periodontist or postgraduate class, so we founded in Atlanta the Southern Academy of Periodontology, fashioned somewhat after the American Academy. The main idea was first to obtain information and later form a sort of bureau to disseminate this knowledge among our dental friends. We determined to bring before our local club of this new society the best men obtainable. We gave from one to three days to our guest, and a small audience (not more than twenty); and as the clinic was held in some well appointed dental office, we were afforded the best opportunity to study and select from the work of each operator the best data for our work.

The book "Clinical Periodontia," by Stillman and McCall, came out about this time and we organized to study this work as a textbook. Every Tuesday, a member would lead the class, covering a chapter, until the book was finished. This education among Atlanta dentists has been of far-reaching benefit.

To many of us who have made some special study of the problem under consideration, there have come those who want our personal instruction.

These experiences illustrate the problems confronting us as to the education of dentists in oral hygiene and periodontia. You have had or know of just such experiences and they will give us a common ground from which to make some deductions and recommendations.

We should feel encouraged because

1. Since the establishment of the first chair of periodontia in 1910, practically every college in our land has established such a chair.

2. Five years ago, there were no textbooks written exclusively on these subjects. Today, there are a dozen or more really meritorious works on prophylaxis and periodontia. From these the general practitioner can gain a fair knowledge, which, if he will follow it up, will make him a better dentist.

3. The program committees of our

dental meetings are now giving time for a better presentation of the subject, and never before has our national meeting program been so full of it.

I here recommend:

That we do all in our power to see that our colleges, not only in name, but in actual fact carry out some definite practical work in oral hygiene and periodontia, and that the faculty as a whole realize and impress upon the student body the real importance of the subject.

That we use our influence with all chairmen of conventions to give more time and prominence to the subject; and hope the present great program will prove of such value that local and state conventions will take notice and do likewise. It is of interest to note that such a program a few years ago would not have been possible, nor would it have been countenanced.

The dentists who come to our offices should be given more attention. Do not just show them a good time, but teach them. Sometimes, we may not just like their being present and hesitate to have them examine the cases in our private practice, but I have found few patients will object if properly approached.

As I have said, my education was received in a large part from visiting private offices, and I wish to say that I am still at it, and never a year goes by that I do not do this. Last month, I went to Montgomery to see Dr. Kirkland, and I hope in time to see many more of you at work. I believe that this visiting idea should be encouraged, and that, if fostered, it will do more to spread the gospel of oral hygiene than anything else.

Let me suggest that you periodontists select, in your city, county or state, men whom you believe would be of value if they knew more of oral hygiene, and invite them to your office to see special cases. If many would do this, the attitude toward, and the complications of, the problem would disappear. Such friendship will do more good than all the papers and clinics you may give. I commend this suggestion to you with the guarantee that you will enjoy some new friendships that you would have missed otherwise.

STUDY CLUB EDUCATION IN ORAL HYGIENE AND PERIODONTIA

We see study clubs formed for the study of nearly every branch except periodontia. Of course, here and there, we hear of the remains of one, but how many have been maintained, as in other branches of dentistry? Is it that we don't know enough to keep these classes together? Is it that the subject is of so little interest that dentists are not willing to give their time as in other branches?

When we consider that the dental hygienist is becoming so active that in some localities she almost threatens the periodontist's very existence, this is a serious question. When we get home, let's revive some of these study clubs, for by so doing we can do much educational work among the practitioners in an effort to change this present indifference.

The following suggestions may not be unwelcome to those who wish to form such a club or clinic.

The clinic will be a failure if the leader tries to dominate and teach only his own pet theories, even though he may know them to be correct. "Familiarity breeds contempt," they say, and this must be the case here; so teach the method of the other man a thousand

miles away—not one method, but one from California, another from New York and one from Georgia. Have different members master the different technics and carry a case through before the class from beginning to end by these separate methods. Use dentists for patients if possible, as suggested in the first part of this paper.

Have one man appointed editor, whose business it will be, at each meeting, to review current literature on periodontia. This means acquaintance with the leaders in the work and lends interest to future study. No matter how many have read Black's "Special Pathology" or Stillman's "Clinical Periodontia," these books should always be reviewed.

The membership in such a clinic or club is often more efficient when selected by the leader who knows their reputation in his city and the men who really will carry out the program. Often, the most enthusiastic volunteers at the formation of the club will fall by the wayside before any work is accomplished. Let it become known that your club will furnish men to give lectures, clinics or papers before other clubs, public schools or district meetings in your locality.

In the late World War, we heard much about "morale," as much as we did about the actual weapons of warfare. If we translate this into terms of this paper, we have the "attitude" that I have previously introduced, as a potent factor for us to endeavor to change. No victory can be won if the "morale" or "attitude" of the profession continues as at present, although most encouraging. Let us find some means to create a real attitude of interest among the dentists generally; then, all these papers, clinics, and modes of operation will prove of greater educational value. When this is accomplished, the education of the general practitioner in oral hygiene and periodontia becomes easy. He will seek it, find it and use it.

THE TEACHING OF ORAL HYGIENE AND PERIODONTIA IN DENTAL SCHOOLS*

By A. W. BRYAN, D.D.S., Iowa City, Iowa

IT is obvious that a discussion of this subject in the allotted time must be of a general nature rather than in detail. We have two distinct and separate subjects to deal with: the preservation of the health of the oral tissues, and the study and treatment of pathologic mouth conditions. While these subjects are distinct, they are of course, closely related in that the neglect of the former leads to the need for the latter. The goal of dentistry is such a complete and masterful education of the public in oral hygiene that periodontal disease will be avoided; and surely it would be a wonderful accomplishment if such could be the case. But this can never be, for the practice of oral hygiene rests with the patient and is dependent on so many systemic conditions that carelessness and lack of interest on

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their part will always involve disease of the mouth tissues in some individuals.

The teaching of these subjects, as of any subject, involves three parts: (1) what shall be taught; (2) when shall it be taught in the course, and (3) how shall it be taught, or the manner of presentation.

We shall consider, first, oral hygiene. Any practice, any habit and any form of living that would tend to maintain a condition of health in the oral tissues may be said to be oral hygiene. While general living conditions, strictly speaking, are included in general hygiene, all the tissues of the body are so intimately related, one to the other, as regards their health that oral health is absolutely dependent on general health. So the teaching of oral hygiene should be prefaced by a consideration of general hygiene. Living environment, air, water, sunlight, etc., are considered. If this subject is taught in another department, its application to oral hygiene should be emphasized in a brief but emphatic review.

In some schools, the study of diet as related to general and oral hygiene is taken care of in a separate department, and in this case, its discussion in the course in oral hygiene may be brief, but the application should be emphatic. Probably, no one thing has a greater bearing on the health of the oral tissues than diet. Adequate diet means normal cell function, normal circulation, normal saliva. Normal saliva means normal environment for dental tissues, and normal diet means proper exercise for the supporting tissues of the teeth, for want of which many diseased mouth conditions are prevalent. Probably, no one thing brought out in recent years will have so marked an effect on the health of oral tissues as the knowledge of the rôle that calcium plays in maintaining the integrity of the tissues involved—bone, teeth and soft parts. Therefore, the student must be impressed with the importance of diet in the maintenance of oral health. This may be taught by means of regular lectures, with slides and models showing the effects of inadequate diet. Some schools conduct feeding experiments with animals to illustrate the point. Much literature is available for teaching material, for a great deal has been done along this line in the last few years. Before the student will be able to teach his patients the proper care of the mouth, he must be trained and become efficient in keeping his own mouth in a state of health. Classes should be drilled in the proper use of the brush, the reasons for using the brush, the choice of dentifrices and their effects on the tissues. Many men are going out into the practice of dentistry with the idea that the toothbrush has only one use—cleaning the teeth. It has been suggested that students have periodical mouth examinations by the faculty and be graded on the condition of the mouth and their efforts at oral hygiene.

Dr. J. O. McCall, in a paper delivered before the American Association of Dental Schools in a meeting in Chicago, gave some good advice as to the place the subject of oral hygiene should occupy in the curriculum. He drew attention to the fact that at least the first two years of the usual dental course is devoted to purely mechanical, restorative work. The students whole attention is directed to restoring lost teeth so that his vision of dentistry is that of restoration. Until he comes into the infirmary for actual work on patients, the thought of prophylactic dentistry and oral hygiene has not been put before

him. As a result, it is very difficult to interest the average student in this kind of work, and usually only one or two members of the class will show any particular liking for this branch of dentistry. Dr. McCall recommends that the subject of oral hygiene be put before the student early in the freshman year so that his vision of dentistry may be that of prevention and conservation rather than only of restoration. I believe that this is a most worthy suggestion and we are trying it out in the University of Iowa this year. At least, a preliminary course of lectures can be given at this time to prepare the student for what is to follow. The course in oral hygiene is so closely related to the course in oral prophylaxis that there will necessarily be repetition, so when the time comes for the student to do his first work in prophylaxis for patients, a more detailed course or a review of the work already given may be taken up. In the past, there has been much confusion in the minds of the profession as to the distinction between oral hygiene, oral prophylaxis and preventive dentistry. To my mind, oral hygiene is not a subject involving any operative procedure on the part of the dentist further than the instruction and demonstrations given to the patient as to the proper care of the mouth and the related care of the general health. So the teaching of oral hygiene in dental schools consists merely in treating the student as if he belonged to the laity, drilling him in the care of his own oral and general health so that he may later use the same methods in instructing his patients. Oral hygiene is purely educational, not operative, in nature. I am inclined to agree with Dr. Towner in his distinction between oral hygiene and oral prophylaxis: the one is the work of the patient, the other the work of the dentist.

We now come to the teaching of periodontia, the study and treatment of diseases of the periodontal tissues. Disease means pathologic change, and in order to understand pathology, we must have a thorough knowledge of histology. A review of the histology of the oral tissues before taking up the subject of periodontia with the class is a wise procedure.

The recent work of Box gives wonderful and ample material for the presentation of this part of the course. Lectures with the use of charts and slides supplemented by demonstrations to the students on the cases available in the infirmary work are used in teaching. The works of Stillman and McCall also give abundant material in histology and pathology.

It is a well known fact among the teachers of this subject that there has been a marked difference in its presentation in the various dental schools. The material used and the time given to the subject have varied greatly in different institutions, and in many schools it is almost entirely neglected. In few schools, until recently, has it been given the attention that its importance deserves.

The success of every other phase of dentistry hinges on the health of the supporting structures, and still restorations are made on teeth and patients dismissed from clinics with practically no thought of the ability of these teeth to carry the restorations. Of what service is a perfect appliance if the tooth carrying it is to be lost within a short time owing to disease of the periodontal tissues? So in the dental curriculum there should be cooperation between the various departments—a cooperation that

is outstanding in its nature so that the students in that school may be impressed with the importance of the health of supporting structures in relation to the life of the restorations they make.

Coming now to a study of the diseases of the periodontal tissues, we find that, in the last few years, much progress has been made in diagnosis and treatment. One of the outstanding changes has been the tendency to get away from so much medication (the treatment of symptoms) and to substitute a more thorough diagnosis and investigation of the etiology, with our main effort in treatment the removal of these etiologic factors. The outstanding work of Stillman and McCall and Box in giving the profession a definite basis for diagnosis, and especially their work relative to occlusal trauma, has done much to put the teaching and treatment of periodontal disease on a scientific basis. And we must not fail to give credit to other members of the profession who have done much valuable work in the study of the pathology of dental tissues.

In determining what shall be taught, it is obvious that here, as in oral hygiene, the student must have a firm basis in other subjects related to that under discussion. A course in general pathology is requisite to a study of a special tissue, and this is usually given by a member of the medical faculty. We will assume then that the student comes to the teacher of periodontia with this part of the work well in hand.

After studying the changes taking place in the tissues involved, he should be impressed with the importance of an accurate diagnosis and study of the etiology. This is the most important factor in the whole procedure; for without a knowledge of cause, we are staggering blindly in our treatment; in fact, our treatment will be purely the allaying of symptoms, and we are back to the day of medication. I have no sympathy with the type of teaching advocated in a paper published several years ago by an operator recommending one particular type of treatment, in which he says, "Entirely too much stress heretofore has been placed upon etiology, histology and pathology and general theoretical discussion, thereby obscuring the simplicity of the curability of this pathological condition and emphasizing the 'so-called' incurability of it." If this method of teaching were applied to all branches of dentistry, we could eliminate all study of medical subjects and give the students only technical work. Mechanics would displace diagnosis. For this reason, I believe great stress must be placed on etiology.

In the consideration of etiology, diet again plays an important part, and the work in different departments frequently overlaps along this line. If the subject of diet is not given by the teacher of periodontia, he must at least review those phases of it that are intimately related to his work and make its application to periodontal disease. To my mind, it occupies a very important position in the etiologic chart, and I was glad to see that, when McCall's chart was revised, this factor was placed in both primary and secondary divisions, rather than only in the secondary as first published.

Another factor on which much emphasis must be placed is occlusion. The student must be trained to study occlusion and detect traumatism, and must be taught how to adjust occlusal relationship so as to eliminate possibility of injury to the supporting tissues. Other

phases of mechanical injury must also be considered.

The part played by systemic disease in lowering tissue resistance and producing circulatory changes should be emphasized.

Special work should be given in interpreting radiograms in the diagnosis of periodontoclasia. Even though the student has had a course in radiography in another department, its application in diagnosis and prognosis of periodontal lesions should be considered by the teacher of this subject.

TECHNICAL TRAINING

I believe that the foundation for the technical work involved in the treatment of periodontal disease is laid in the student's work in prophylaxis. This is the first work that he does in the infirmary, and the manipulation of instruments in prophylaxis is practically the same as in the treatment of periodontoclasia. True, he has additional instruments and some of a different type, but attainment of finger dexterity and the development of a delicate sense of touch comes in his work in prophylasis. Therefore, a well-taught course in prophylaxis is fundamental, and it is well if it is handled by the teacher giving the course in periodontia.

Before coming to the infirmary, the student should have had some training on models, and many valuable suggestions have been made by various teachers along this line. The placing of artificial deposits on the roots of teeth mounted in rubber sets after the operative department have finished their work on these models is worthy of consideration. These have been suggested by Dr. McCall.

One of the hardest questions to settle in the teaching of periodontia is that of the method of treatment to be followed routinely by the student in the infirmary. It is obvious to the teachers of this subject that, no matter what method is taught in a school, there is bound to be criticism by advocates of other methods of treatment. The student should be made familiar with the accepted methods of medicinal, mechanical and surgical treatment, and a conservative, efficient method should be used in the infirmary for routine work. Emphasize that the rational treatment of any disease is the removal of the cause. No matter what method is used to eliminate the symptoms of periodontoclasia, the cause must be found and removed or these symptoms will appear again, and quickly. Many advocates of so-called "quick cures" consider only symptoms in their work.

Instrumentation of involved tooth and bone surfaces is essential in any method of treatment, whether it is associated with medicinal or with surgical procedure.

I wish to raise an objection to the teaching in dental schools of the use of proprietary preparations put out by different dental manufacturers. Dr. J. P. Buckley, who has done so much to put dental therapeutics on a scientific basis, once said, in an address before dental students, that successful therapeutics depended on three things: an accurate diagnosis, knowing what drug to use and knowing the action of that drug. Students should not be allowed to use any preparation without a knowledge of the formula and the action of every drug in it. This rule should apply in root canal therapy also. One manufacturer compliments the profession highly by saying that the formula and chemical reaction in his preparation

is so complicated that the dentist would not understand it if it were given. This preparation, by the admittance of the manufacturer, in their house journal, has been adapted to the treatment of everything from pyorrhea to piles, from eczema to boils. The use of these preparations should not only be prohibited in the school but also should be discouraged after these men enter practice. A good course in materia medica and therapeutics will give them a choice of drugs that, when drugs are indicated, will do anything a secret formula will do, with the added advantage that the operator is not working in the dark.

Finally, the student should be taught how to instruct his patients in their part of the work so that the tissues, once placed in as healthy a condition as possible, may be kept that way. Also, the matter of charts and records must be emphasized, for it is in this way that the practitioner is able to keep track of his cases and give them the periodical attention that they require.

There are many phases of the work that it has not been possible to consider in this brief time, but I believe the most important points have been brought out. Gradually, the subjects of oral hygiene and periodontia are gaining the places in the dental course that their importance deserves and demands.

DISCUSSION

A. E. Webster, Toronto, Canada: Dr. Bryan is to be complimented on the clear, rational and common sense point of view of teaching this subject. He has avoided the pitfall of forcing the subject into places where it does not belong. It must gradually find its place in an already crowded college curriculum without displacing anything else essential. Time will place this subject as among the most important on the curriculum. The choice of the title of this paper is rather unusual. Just why the most important branch of the subject of oral hygiene should be left out of the matter under discussion is not clear. Dr. Bryan himself could not avoid the discussion of oral prophylaxis, though it is clear it was not intended. In the minds of many, there is some confusion as to the terms employed to describe the conditions found and the methods of treatment. Dr. Bryan uses the term preventive dentistry to mean the discussion of the means of prevention of disease before there are any symptoms or pathologic changes present. Oral hygiene means those measures employed by the patient to keep his mouth and teeth clean and thereby prevent disease both general and local. Oral prophylaxis means those measures undertaken by the dentist to prevent disease of the mouth and teeth, and by so doing prevent general disease. It is not intended to include filling operations, the placing of crowns, bridges and dentures, or orthodontia. These definitions are not strictly accurate, but, by common consent and usage, they have very circumscribed and specific meanings. I agree that the student in his first year should receive several semipopular and semiprofessional lectures on oral hygiene and even oral prophylaxis, but these should run concurrently with or closely follow the study of oral and dental anatomy, and physiology. It is a crime against dental education and the public to teach the dental student nothing but mechanical procedures and dry bone for two years or even three and then face about and try to teach him in his last year or so that the living patient is the real thing and that all his mechanics are of no avail if he knows no psychology, physiology, pathology, medicine or surgery and cannot diagnose and treat disease. Primary subjects are only fundamental when they can be applied to practice. It is a good plan to start each student off on oral hygiene for himself, but, in many cases, it is impossible to have a hygienic mouth because of the need of oral prophylaxis. Therefore, an advanced student should be held jointly responsible with the freshman, for his oral condition. Oral prophylaxis, which is the backbone of oral hygiene, preventive dentistry and the prevention of the acute infectious diseases should be taught in a well-graded and complete laboratory course, covering anatomy, physiology, dental caries, salivary calculus, peridental relations, hand grasps, instrumentation, the use of the dental engine,

wheels, stones, brushes, polishers, grits, etc.; in all, about fifty hours. The more difficult technic, pathology and therapeutics of periodontia should be taught along with oral prophylaxis, but after the student has seen patients for other operations. Dr. Bryan strikes the usual and generally correct note against proprietary medicines. I don't wish to be on the wrong side of this question, but I listened to the condemnation of proprietary remedies in the lectures on medicine and therapeutics at a well known medical school and then went to the outdoor clinic where the staff prescribed treatment for patients by number. Wherein is the difference between prescribing a proprietary or a numbered compound? All prescribing in the army is by number. The constituents are forgotten by the prescriber and surely they are not always in the correct proportion for every patient. I doubt if there is a dental infirmary in which there are not half a dozen proprietary drugs in common use, so why wonder or object if graduates follow the practice of prescribing such remedies? The practice will never stop until a better plan is followed by teachers. Let me add that there should be a few lectures and demonstrations in the applied physics department on mechanics. These should be given as part of the course on the physiology of occlusion. The chief difficulty in teaching the subject of oral hygiene and periodontia to practitioners is that the operator, as a student or graduate, has to wait so long to see whether what he has done is going to be a real success or not. The other great difficulty is that few graduates of years' standing know enough mechanics to understand matters of occlusion, or enough histology and pathology to understand the disease processes in this field. He can make a filling and at once rejoice at its perfection or remove a tooth and tell his patient to go on his way and suffer no more. Not so in periodontia. The subject is too complex to be grasped in one lecture, one clinic, one essay or one course. All the foundational subjects of health and disease are involved in this study, so it is little wonder that students cannot see anything to interest them in comparison with major surgery and gold inlays. The graduate soon gets set in his ways and must be awakened by first seeing something and soon after doing it himself. Hence, study or reading books and essays alone will not advance the graduate very far. My suggestion would be: see clinics, listen to talks, buy equipment, join study clubs, read essays and books on treatment, and read and study foundational subjects, visiting others interested in the same subject and attempting to teach and demonstrate to others.

THE TEACHING OF ORAL HYGIENE IN SCHOOLS*

By SIDNEY J. RAUH, D.D.S., Cincinnati, Ohio

THEORETICALLY, all dentists believe in preventive dentistry, as do all laymen. Practically, more than 90 per cent of the formers' time is spent in removing and substituting teeth (including fillings, which do not come under the head of preventive work).

Forty million toothbrushes were used in the United States in 1923; showing that less than 20 per cent of our people even own, much less fairly efficiently employ, one. Therefore, our problem resolves itself into something like this: The time of 10 per cent of 40,000 dentists, or 4,000 dentists, must reach 80,000,000 people. This estimate does not include about 30,000,000 persons who come under the more or less general direction of active practitioners. To this must be added one important rapidly growing educational factor not mentioned above: public health officials, nurses, dental hygienists and all others interested in health work who have in

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recent years very actively taken up mouth hygiene.

Therefore, the teaching of oral hygiene in schools appears to be our only important educational opportunity, for there we reach from 15 to 20 per cent of our population. If well organized instruction, beginning with the child's first contact with school, and continued through high school, be maintained, a worth while result is assured.

Casual lectures and demonstrations through the medium of the movies are of great value. They, however, will produce results only in proportion to their frequency, and their effectiveness will depend largely on the personality of the speaker plus his knowledge and enthusiasm.

To outline a uniform program for all communities is almost valueless, for, at the present time, they vary from those larger cities, with magnificent school buildings, having health clinics, etc., assisted by trained experts in all lines, thoroughly cooperating, to the isolated district with the one-room country school equipped with nothing.

The medical fraternity, with rather rare exceptions, is not sufficiently impressed with mouth conditions as they exist. Whether even the average dentist takes in the situation, overwhelmed as he is by the problem of making a living, is doubtful. To arouse these forces is one of the first and most important steps in teaching oral hygiene in schools, for without their absolute moral support—"what's the use?"

The dental hygienist is the trained nurse of dentistry, and she is becoming, as is proper, the instructor of children. Comparatively few men have the temperament to instruct young children consistently. There are no male teachers in elementary schools!

These are the known means for instructing or teaching children in mouth hygiene: (1) lectures; (2) demonstrations: (*a*) health shows, (*b*) toothbrush drills and (*c*) movies; (3) dental inspection; (4) individual instruction by dentists in private practice; (5) individual instruction by hygienist or other worker; (6) pamphlets; (7) school books.

Talks to groups of children have the advantage of being comparatively easily arranged. They interfere with class routine only slightly, but unfortunately results are just in proportion to the time, energy and ability expended. It is manifestly impossible to describe in one paper talks to children of 5 or 6 years, and on up to university students.

If a group of children are to be impressed, it must be largely through visualization or the kindergarten method. Nothing much more than a demonstration of tooth brushing should be attempted with children of this age.

In order to present something definite and practical, we shall attempt to formulate a lecture for a group of children of about 13 to 15 years. The main points to be stressed are: (1) cleaning the teeth and mouth: how? (*a*) tooth brushing, (*b*) mastication, (*c*) floss silk, (*d*) mouth washes and (*e*) dentifrices; (2) diet; (3) deciduous teeth; (4) first molar; (5) anatomy and physiology; (6) relation of the mouth and teeth to systemic diseases; (7) hygienic mouth as related to athletics, appearance and general health; (8) relation to speech; (9) orthodontia—irregular teeth; (10) enlarged tonsils and adenoids, proper breathing; (11) repairing, including fillings, artificial

teeth, crowns, bridges; (12) human elements: stories, demonstrations, use of models and pictures, large toothbrush, children demonstrating brushing, toothbrush drills, songs, prizes.

While it may appear that lecture work is stressed, it must be emphatically understood that this is done only because in no other way can large groups be reached in a limited time. Ideally, the program should embrace:

a. A well equipped and manned dental clinic, in conjunction with a general health clinic, located in the school building.

b. A prophylactic clinic in which every child is received unless he have a certificate from his private dentist.

c. Regular periodic instruction from the dentist, hygienist, school teacher, school physician, nurse or social worker.

d. General dental inspection at least twice a year, followed up by a report on the findings to both parent and child.

e. Distribution of pamphlets to the children and to the home in order to interest the rest of the family.

f. Compilation of statistics to demonstrate the effects on scholarship, weight, growth and general physical development; also the effect of a hygienic condition of the mouth in controlling contagious disease, school attendance and character.

g. Experimental dental class with control to demonstrate the foregoing.

h. Movies.

i. Prize contests for classes and individuals.

j. Newspaper publicity.

k. Exhibits.

At times, a very pessimistic outlook prevails in the minds of those who have been concerned with the problems of preventive dentistry, when the mouths of large numbers of children are seen. On the other hand, when we take into consideration that, twenty-five years ago, practically nothing was even attempted and compare what has been accomplished in Bridgeport, Conn., Boston, Rochester, Cleveland, Philadelphia, Cincinnati, Detroit, Chicago and the growing movements in literally hundreds of centers, large and small, we begin to vision a future of real results.

The mere fact that advertisements of brushes, pastes, powders and all other accessories for prevention cost many millions of dollars each year indicates that business sees the trend of the times. Someone must purchase these commodities.

A larger force of dentists, hygienists and health workers must be developed and the demand for their services will increase as their usefulness is shown.

In a brief paper only the main points can be stressed. Attention is called to models, slides, brushes, etc., all of which are necessary for publicity propaganda.

If the American Academy of Periodontology desires any real results, it will be necessary to carry out all these points with papers or demonstrations at a session similar to this symposium.

Practically all these methods are applicable to groups of mothers or adult audiences; for, in the final analysis, it is only through the cooperation of all individuals, young and old, and all agencies, that real results can be expected.

THE RISK OF DENTAL SURGERY, ESPECIALLY IN CASES OF CARDIOVASCULAR DISEASE*

By ARLIE R. BARNES, M.D., Rochester, Minnesota

IN this age of specialization, dental surgery has become an important branch of general surgery, employing similar standards of technic, requiring a high order of skill and training, and being subject to the rules that govern surgery in other fields. It is subject, moreover, to similar risks, but this fact is not fully appreciated, according to the testimony of leading exodontists. It appears, therefore, that the patient's best interests are not served unless a careful medical examination is carried out before dental operations are undertaken. There are numerous abnormal conditions that may cause disaster, only the most important of which can be considered here.

It is estimated that there are 1,000,000 cases of diabetes mellitus in the United States today. Foster[1] says that, of the diabetic patients with lesions requiring surgical treatment, more than one-half enter his hospital service without any knowledge that they have this disease. The leading authorities on diabetes mellitus warn us that the most conservative operations, especially if infection is superadded, can convert a case of mild diabetes mellitus into a severe case, and a severe case into a dangerous or fatal one, unless adequate preoperative preparation is carried out. Wilder and Adams[2] assert that, in former years, the mortality of operations on diabetic patients ranged from 12 to 30 per cent even in the better hospitals. In 1921, Berkman[3] reported 233 operations performed on 201 diabetic patients at the Mayo Clinic, with a mortality based upon the number of operations, of 6.4 per cent, and of 7.4 per cent based upon the number of patients. In 1923, Wilder and Adams reported from the Mayo Clinic a series of 327 operations on 251 diabetic patients, with four deaths, a gross mortality of 1.2 per cent. Insulin was available for some in the latter series. These results were obtained largely by virtue of adequate preoperative and postoperative care, and the close co-

*Read before the American Society of Oral Surgeons and Exodontists, Louisville, Ky., Sept. 18 and 19, 1925.

1. Foster, N. B.: Some Surgical Aspects of Diabetes, J.A.M.A., 84: 572-576, (Feb. 21) 1925.

2. Wilder, R. M., and Adams, S. F.: The Present Status of the Diabetic Patient as a Surgical Risk, Wisconsin M. J., 22: 557-561, (May) 1924.

3. Berkman, D. M.: The Diabetic Patient as a Surgical Risk, Collected Papers of the Mayo Clinic, Philadelphia, W. B. Saunders Co., 1921, Vol. 13, pp. 1177-1181.

operation between medical and surgical services.

It has long been a custom at the Mayo Clinic to refuse operations of all kinds to patients suffering from hyperthyroidism. The only exception to this rule is made in cases in which strictly emergency operations are required. It is a well substantiated observation that even so simple a measure as dental extraction, if the patient is suffering from hyperthyroidism, may aggravate that disease to an alarming or uncontrollable degree. Plummer and Boothby[4] have pointed out the greatly increased safety that can be conferred on a patient with exophthalmic goiter by preliminary preparation with iodin (compound solution).

The dental surgeon faces dangers from hemorrhage. While the designation, "a bleeder," is too often used to excuse poor hemostasis, there are well authenticated cases of death due to hemophilia following minor surgical procedures. This defect in coagulation may be suspected if the patient is a male and gives a history of obstinate hemorrhage on other occasions, especially if male ancestors in the mother's line have been subject to excessive hemorrhage. In general, any history of excessive hemorrhage calls for a thorough investigation of the coagulating properties of the blood before the patient is submitted to operative treatment. Locher[5] reports a case of alarming bleeding in a patient with hemophilia following dental extraction, and says, "Here let me say, 'Be sure of your patient; obtain a complete history.' This is essential, for it is the ninety-ninth case out of a hundred that will bring you grief."

The presence of anemia, especially if it is severe, calls for a thorough investigation of its cause and severity. Transfusion before operation, or preparation for it after operation, should the necessity arise, is indicated when the anemia is severe or when extensive operative treatment is attempted.

Acute respiratory infections constitute a grave contraindication to operative treatment in general surgery, and, to this rule, dental surgery furnishes no exception, especially if a general anesthetic is employed, because of its tendency to irritate the respiratory mucous membrane and the danger of inspiration of the extracted tooth. It must not be forgotten that dental surgery deals with purulent processes. The aspiration of this material may lead to the much dreaded and all too frequent complication of lung abscess. From that standpoint, local anesthesia seems the method of choice, when practicable. Certainly, it is clearly indicated in any dental operation performed in the known presence of pulmonary complications.

The anesthetics employed in dental surgery have been shown to be safe by their use in general surgery in a wide variety of conditions and in greatly varying amounts, provided they are skilfully given. The general surgeon has learned that no anesthetic is without danger if the patient is allowed to lie in blood-soaked sheets or to lose much

4. Plummer, H. S., and Boothby, W. M.: The Value of Iodin in Exophthalmic Goiter, J. Iowa State M. Soc., 14: 66-73 (Feb.) 1924.

5. Locher, E. E.: Extraction for a Hemophiliac, Dent. Cosmos, 67: 48-50, 1925.

body heat under those conditions. It cannot be emphasized too strongly that failure to combat the loss of body heat during operation shares almost equally with loss of blood and undue prolongation of anesthesia in the production of shock. A patient chilled on the operating table is a favorable subject for postoperative pulmonary complications.

It is a dictum of general surgery that the extent of operations performed at one time must be determined by the patient's condition. There is less and less tendency to perform multiple abdominal operations at one time, especially if the patient's condition is known to be grave. This principle is extremely important in dental surgery. Gardner[6] has stressed this point and has given some practical suggestions concerning the extent of operative treatment and the choice of time at which the operation is to be performed. Within the week, I have been told of a physician who had all of his teeth extracted at one time. A week later, he died from acute nephritis complicated by empyema. The principle of metastatic infection is the corner stone of dentistry. It must not be forgotten that the body can withstand the discharge of small numbers of bacteria into the blood stream, but may succumb to the liberation of massive infectious material.

Cardiovascular disease is truly the "captain of the men of death," leading, as it does, all other diseases in present-day mortality statistics. Recent analyses indicate that one death out of every five after 40 years of age is due to cardiac disease. This means that a great many more than one-fifth of our population past 40 are victims of some form of cardiovascular disorder.

Hypertension and arteriosclerosis, with their resultant degenerative changes in the heart and in the vessels of the brain and kidney, include by far the greatest numbers of cardiovascular disorders encountered after the age of 40. In the newspapers, almost daily, are accounts of sudden deaths due to these causes among the leaders in all walks of life and at comparatively early ages. The truth is that these deaths have come to be recognized as the product of a successful and aggressive life. A certain type of person seems prone to develop chronic cardiovascular degeneration. It may be suspected among men of large affairs and men of great physical prowess. It is predominantly a disease of the male sex and gives rise to symptoms mainly after 40 years of age. The patient is prone to be overweight, thick of chest, with a short neck, and often with the ruddy complexion of excellent health. Only too often he insists that he feels physically fit until suddenly he is overtaken by death. In short, he has lived too hard and too well.

In our attempt to combat this growing national menace, enlightened dentistry is a mighty ally in its gospel of eradicating infection.

At the outset, it may be said that surgical risk in cardiovascular diseases is determined not so much by the recognition of valvular defects, the presence

6. Gardner, B. S.: Extraction of Teeth: Amount of Surgery Feasible at One Time, and Treatment in Acute Cases, Dent. Cosmos, 67: 661-663, 1925.

of cardiac hypertrophy or dilatation or the knowledge of etiologic factors contributing to myocardial injury, as by the knowledge of the functional capacity of a handicapped heart. The crux of the matter is to decide whether there is unwarranted dyspnea, pain or tachycardia on exertion, with edema thereafter. As long as its defect is compensated, the heart responds naturally to moderately increased exertion without the production of any of those symptoms, and, in the presence of good compensation, I know of no valvular defect or degenerative cardiac condition that constitutes a contraindication to an anesthetic skilfully given or to surgical procedures carefully performed.

Angina pectoris is the most serious syndrome that confronts the surgeon. It causes most of the sudden deaths from heart conditions. It is a syndrome the cardinal symptom of which is substernal or precordial pain, which radiates into the left arm, in the most typical cases. The pain is characteristically brought on by exertion or excitement, or by the ingestion of a large meal, and is relieved by repose. The attacks are often attended by a fear of impending death. If a diagnosis of angina pectoris is made, the degree of functional impairment of the cardiac muscle must be carefully assessed. If the compensation is good, operation may be indicated and justifiable in the face of this disease. Everyone concerned should be fully cognizant of the increased risk entailed. Relatives and friends, forewarned of the special risk in operating on patients with angina pectoris, will be less inclined to criticize the surgeon if an unfortunate accident occurs. In the face of this increased risk, small surgical procedures may be chosen in dentistry to test the patient's tolerance for operation.

Similarly, the presence of hypertension, especially if it is extreme, calls for the investigation of the functional capacity of the heart before the patient is submitted to operation. If there is a history of cerebral hemorrhage, or if it seems imminent, great caution should be employed in the use of pressor drugs, which tend to raise blood pressure; and if a general anesthetic is employed, it should be given with special skill to insure a smooth induction of anesthesia, with the least possible struggle on the part of the patient.

In this connection, aside from the all-important information that may be derived from a careful history of the patient's response to effort, the electrocardiogram furnishes a great amount of information concerning the state of the myocardium. We may learn from the electrocardiogram whether delays occur in the transmission of the cardiac impulse from the auricles to the ventricles; whether the impulse travels in its normal course and consumes a normal time in its propagation over the ventricles, and, finally, whether irregular types of cardiac rhythm are present which are significant of cardiac impairment. In short, the presence of partial or complete heart block, arborization block, auricular fibrillation and flutter, and significant T-wave negativity is disclosed. It is now recognized that these abnormalities not only signify impaired cardiac function, but have a definite

value in indicating life expectancy. Willius[7] has shown that negativity of the T-wave in Derivations I; I and II; I, II and III, and II and III are attended by a total cardiac mortality of 50.4 per cent in eleven and two-tenths months, as compared to a cardiac mortality of 22.3 per cent in nineteen and two-tenths months in cases clinically similar but lacking these significant abnormalities in the electrocardiogram. He has further shown that the combination of these abnormalities of the electrocardiogram, with aberrant QRS complexes in all derivations, carries with it a mortality of 86.7 per cent in twelve and seven-tenths months. Certainly, if death appears to be imminent, as indicated by these findings, surgery should proceed circumspectly, and the risks incurred should be understood by all.

Valvular cardiac defects constitute no contraindication to operation provided the patient's response to effort is satisfactory. The history is the most reliable source of determining the functional capacity of the heart. Particularly is it to be urged that by no simple rule of thumb, such as ability to hold the breath, can a satisfactory estimate of surgical cardiac risk be made.

It is not contended that grave risks attend dental surgery in a very high percentage of cases. Willius has pointed out that there are few cardiac conditions that are a bar to operation provided they are recognized and the patient is properly safeguarded by adequate preparations, particularly if the anesthetic is skilfully administered and the surgical procedures are planned with a view to sparing the patient undue risk. But the diseases I have mentioned constitute real dangers and are present occasionally in patients who require dental operation. The dentist, the patient and his friends have a right to know the risk and to be assured that the proper safeguards are employed against disaster. The dentist has a right to insist on the proper safeguards, not only for the patient's sake, but also in order that dental surgery may not suffer unmerited criticism.

7. Willius, F. A.: The Operative Risk in Cardiac Disease, Am. J. Surg., 32: 121-124, (Oct.) 1918. Electrocardiography and Prognosis, Arch. Int. Med. 30: 434-450 (Oct.) 1922.

CONCLUSIONS

1. The dental surgeon faces the same risks and assumes the same responsibilities for the safety of his patient as does the general surgeon.

2. Diabetes mellitus, hyperthyroidism, hemophilia, anemia and acute respiratory infections constitute grave surgical risks and require careful preoperative evaluation and management.

3. Loss of body heat shares with prolonged anesthesia and loss of blood an important place in the production of shock.

4. The principle of gaging the magnitude of the surgical procedure by the patient's condition holds in dental as well as in general surgery. Limited surgical procedures should be employed as a test of the patient's tolerance in cases of high risk.

5. The operative risk due to cardiac disease depends on the history of the patient's response to effort. If effort is not followed by unwarranted

dyspnea, pain or tachycardia, with edema thereafter, the heart is compensated and operation may be safely undertaken.

6. In cases of hypertension, the functional capacity of the heart should be investigated before operation is undertaken.

7. The electrocardiogram discloses partial or complete heart block, arborization block, auricular flutter and fibrillation, and negativity of the T-waves. All these findings give valuable knowledge of the functional condition of the heart, and are of definite value in prognosis.

8. Angina pectoris, the most serious syndrome confronting the surgeon, causes most of the sudden deaths from cardiac disease.

9. Dental operations may be performed in the face of high risks, but the risk should be carefully assessed before operation and reduced by appropriate methods.

10. The patient, his friends and the dental surgeon have a right to know the risk assumed, as far as it can be estimated.

DISCUSSION

R. Boyd Bogle, Nashville, Tenn.: The risk in cardiovascular cases is one which confronts us continually. It is therefore important that all precautions be taken in the management of cardiovascular cases. The carefully taken history is of great importance. While often incomplete, it affords opportunity for the investigation of probable present conditions that should be determined before operative procedure. One of the most important preoperative measures is the general physical examination. This should always be made, not in a half-hearted way, but by the internist who examines his cases carefully. In the advice following his findings, we come to the nearest possible way of properly managing not only the cases of moderate risk, but those of the more serious types as well. One of the most valuable phases of the internist's advice is the probable limitation of the patient's resistance in surgical procedure, based upon his finding, and his opinion as to how far we may safely proceed at any time in removing focal infection in a patient who has already a secondary involvement. Dr. Barnes stressed the danger of surgical risk in patients affected with diabetes mellitus, hyperthyroidism, hemophilia, acute anemia and the acute respiratory infections. The carefully preoperative evaluation of these cases is essential to safety, and, without the assistance and counsel of the internist, we would often face disastrous results.

The risk assumed should in all cases be made known to the family of the patient and his friends, and often it is well that the patient be advised as to his condition—the responsibility assumed and the possible outcome, particularly in borderline cases of the types just mentioned.

Earle H. Thomas, Chicago, Ill.: I do not think anything more important than this subject could be presented before our society. Its presentation has been most timely, and we should thoroughly familiarize ourselves with every thought to which Dr. Barnes has called attention, if for no other reason than that mentioned in the last sentence of the paper: "that dental surgery may not suffer unmerited criticism." I do not think it is a waste of time to repeat the first two or three sentences of this paper. "In this age of specialization, dental surgery has become an important branch of general surgery, employing similar standards of technic, requiring a high order of skill and training, and being subject to the rules that govern surgery in other fields. It is subject, moreover, to similar risks, but this fact is not fully appreciated." These statements are the basis of my feeling that the paper is a most important one and comes to us at a time when it is most needed. From now on, let us appreciate more fully the risks we are taking, and properly safeguard our patients in every way possible. And this is such a simple thing to do in most instances—a few questions as to the patient's history and general trouble, a call on the

'phone to his physician if it seems advisable, taking a drop of blood to determine its coagulating properties, using the proper anesthetic according to the circumstances and administering it in a skilful manner, restricting the amount of operative interference when indicated, etc. All of these are simple, the main requirement of the dental surgeon throughout being good judgment; and it seems to me that it is along this line that we should be bending our energies most—in developing our judgment. Dr. Barnes has corrected a few wrong impressions that seem to be held by not a few men in our line of work, and, along this line, I should like to repeat a statement of his in regard to heart conditions: "The crux of the matter is to decide whether there is unwarranted dyspnea, pain or tachycardia on exertion, with edema thereafter. As long as its defect is compensated, the heart responds naturally to moderately increased exertion without the production of any of those symptoms, and, in the presence of good compensation, I know of no valvular defect or degenerative cardiac condition that constitutes a contraindication to an anesthetic skilfully given or to surgical procedures carefully performed." I should like to give a word of advice to physicians. They should notify every patient presenting as a poor operative risk that, in case teeth have to be extracted at any time, the dental surgeon should get in communication with the physician in order that he may be informed of the patient's general condition. I feel that the energy Dr. Barnes has put forth in preparing and presenting this paper has not been wasted—it will do a great deal of good.

Emmet F. Horine, Louisville, Ky.: With cardiovascular disease so prevalent, it is necessary that oral surgeons employ every possible safeguard. We must all agree that the patient's best interests are not served unless a medical examination is made before dental operations. In Louisville, the oral surgeons appreciate this necessity, judging from the number of patients sent to me for a cardiovascular survey. In cardiovascular disease of any type, the examining physician must evaluate the condition of the heart muscle itself in order to give a correct opinion concerning the individual's ability to take a general anesthetic. It is assuredly true that, with a heart muscle in good condition, even though decided valvular impairment is present, an operation may be safely performed. Our opinion concerning the advisability of a patient taking a general anesthetic is, therefore, largely based upon our findings concerning the heart muscle itself and to only a limited degree on valvular impairment. In addition to the so-called functional tests to determine the efficiency of the myocardium, I have found the electrocardiogram of definite value. It furnishes us with information concerning the muscle mass that can be obtained in no other manner. It was impossible for Dr. Barnes, in the limited time at his disposal, to discuss the selection of the anesthetic for the heart case. For this reason, I desire to emphasize especially the markedly lessened risk in heart cases secured by the employment of infiltration and conduction anesthesia. I realize that these methods are not always advisable, and, further, that they are sometimes difficult and more time-consuming than general anesthesia. But with the life of the patient at stake, a safer procedure, even though more difficult and tedious to the surgeon, is certainly the one to employ.

J. A. Heidbrink, Minneapolis, Minn.: I wish to ask Dr. Barnes to tell us briefly what he thinks the general procedure of the exodontist is regarding preparation for tooth extraction, and whether all patients should have that examination. Certainly, that would be a marked departure from our procedure.

Dr. Barnes: I had hoped that this question would not be asked because I realize that in private practice one cannot come up to this ideal. In estimating risk, a number of factors should be considered. If surgical procedures are limited in extent, and if the patient is of an age (under 40) when serious degenerative conditions are relatively uncommon, there is much less need for a physical examination than if the patient is over 40. An obese patient needs careful physical examination before operation is undertaken. Much may be learned from asking a few simple questions: whether the patient has hypertension, dyspnea, chest pain, etc. Many patients will know whether sugar has ever been found in the urine. Most men and women today carry

life insurance and have periodic examinations. An inquiry concerning any physical defect disclosed by these examinations will serve as a valuable clew to the need for further examinations. A careful history of each case may be obtained in physicians' offices, and if this leads to a suspicion that any one of these conditions is present, a careful examination of the case should be made by an internist.

Arthur E. Smith: I should like to ask Dr. Barnes if it makes any difference whether the patient is to take nitrous oxid, ether or a local anesthetic.

Dr. Barnes: There would be no difference as far as cardiovascular conditions are concerned. At least in the Mayo Clinic, I should say that we would make little distinction between nitrous oxid and ether. They are both general anesthetics. Whichever is chosen must be administered skilfully. The struggling of patients with high blood pressure may be a dangerous factor. There is one precaution I see necessary in the use of local anesthetics. In the case of patients with high blood pressure, care must be taken in regard to the amount of epinephrin administered. I think a more specific rule than that could not be laid down without a long discussion.

A. P. Williams, Louisville, Ky.: I should like to ask Dr. Barnes whether he would consider procain and local anesthetics in cases of angina pectoris.

Dr. Barnes: That would depend on whether angina pectoris was associated with high blood pressure. In such cases, a local anesthetic may be employed, provided the amount of epinephrin used is minimal. In the Mayo Clinic, we have used local anesthetics in our cases of angina pectoris, and I do not recall a single case of accident. I have a feeling that the surgical deaths in cases of angina pectoris are not necessarily due to the anesthetic or to the surgical procedure, but are coincidental. In certain serious cases of angina pectoris with operation under general anesthesia, the patient may reach a period of convalescence when the stress of the operation is largely over, and develop evidence of serious myocardial failure and die. I do not believe that the death is due to operation, but is, rather, coincidental. For this reason, if angina pectoris is known to be present, everybody concerned should know it, and know that it presents an increased risk, a part of which is independent of the surgical procedure.

CORRECTION OF UNBALANCED ADULT OCCLUSION*

By H. B. WASHBURN, D.D.S., Saint Paul, Minnesota

DENTISTS everywhere recognize the fact that there have been many decided changes in dental thought and practice during the past 100 years. These changes are as they should be, beginning as they did at the time when dentistry was crude but withal constantly being led forward by the consciousness that the ideal in dental thought and practice was ever in advance. One familiar with Harris' "Principles and Practice of Dentistry," published in the early part of the nineteenth century, can appreciate how dental operators of that early period were influenced by the consciousness that some day dentistry would reach its goal as a science and an art. More evidence of change has been manifest in the past twenty years than in any like period in the history of the profession. Bringing the focus down to a still finer point, the present time appears to give evidence of the greatest change in dental thought, education and practice of all time.

In this mutation of thought concerning the problems as to how best to prevent loss of function of the organs correlated in mastication, it seems desirable that there be conversion rather than revolution. Gradual change in thought is to be preferred to rapid change, for the reason that an opportunity is thus afforded competent researchers to seek the truth and practicability in the new thought, finally leading to a sound basis as justification for any change from older preconceived ideas. We, as members of the dental profession, should rejoice in any evidence of dissatisfaction with things as they are, for a complacent attitude in the profession would indicate a lack of desire to keep up with the other sciences.

Perhaps the best evidence of a desire among dentists to keep pace with the progress of the world is found in the records of our national organization, now known as the American Dental Association. As one instance, there was a time when all of the ideas concerning denture and crown and bridgework were presented in one section, the prosthetic section. A gradual change of thought brought about a desire for two sections; thus, we now have the full denture and the partial denture sections. When first organized upon this new basis, there was danger that the partial denture group would confine its work and discussion to the various types of lost tooth replacements representing the pet ideas of mechanical geniuses, without first obtaining a thorough knowledge of the broad fundamentals underlying occlusion. However, the fact that the profession is rapidly losing patience with

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the purely technical type of discussion that is wholly interested in substitution of lost teeth, but gives nothing of a fundamental character, is outstanding proof of real progress at this time. What the partial denture group seems to be demanding is a better understanding of natural tooth occlusion, feeling that it will be comparatively simple to devise ways and means of reconstruction when once the foundation is comprehended.

Obviously no one man or one group of men can solve the mysteries of human occlusion. We must have a larger number in the profession who are thirsty for accurate knowledge of human occlusion—the best types, the worst types and all the types in between, and what each means in health and comfort to the patient. A satisfied attitude with our work today is to be deplored, and the hope is expressed that this paper may stir in you the desire for keener observation, for fundamentals before technics and a willingness to record accurately observations and results of reconstruction. It seems that only by so doing can we eventually reach a point of common understanding.

As evidence of these changes in conception of jaw and tooth relationship, there are four outstanding points that may be worthy of notice:

1. There seems to be a pronounced change of thought among the leading investigators from a consideration of individual teeth or spaces to a study of all associated structures involved in the function of mastication.

2. There is now a realization that no one person can in a lifetime solve dental problems and produce a device for replacing all types of lost tooth areas.

3. Dentistry is demanding comprehensive research in addition to what is being done along bacteriologic lines, research dealing with the fundamentals of jaw relationship.

4. The periodontist, through keen observation, careful study and large experience, is pointing out the similarity of the problems confronting the orthodontist and the prosthodontist.

As we approach the subject of the correction of unbalanced adult occlusion, it may be well to attempt a careful analysis of various tooth and jaw relationships as we find them, with the purpose of making clear our understanding of the differences between a balanced and an unbalanced condition or relationship. As a matter of fact, the discussion in this paper is more concerned with the need of recognizing unbalanced occlusion than with the technical steps necessary for treatment. We are reminded at this point of a tendency to take for granted what is promulgated concerning the need for any plan of action and to be chiefly interested in the actual steps for carrying out the plan. In dentistry, we see the tendency to accept, or at least consider indifferently, the fundamentals and principles presented to us concerning the oral cavity, and to be chiefly interested in the technical steps for carrying out any particular type of reconstruction whether it be one tooth or more. Do not be too ready to pass judgment on what is here presented, but rather carry the suggestions to your practice, and only after several months of keen observation will you be ready to declare whether or not there is merit in any of the suggestions made. In other words, these statements are merely by way of stressing the importance of careful observation and accurate analysis of all tooth and jaw conditions before

technical procedure for any type of reconstruction is considered.

For the purpose of observation and analysis, let us liken the human masticatory machine to a man-made machine. Dental writers frequently refer to the masticating apparatus as a machine. The more mathematical and mechanical we are, naturally or by training, the more machine-like the function of the jaws appears. One who has studied the most delicate and precise type of machine made by man and has learned by such study how each part depends on the correct fitting of all other parts for complete function, and has learned further how quickly the whole machine goes to pieces when mutilation of any essential part occurs, can easily understand how the human masticating machine soon tears itself to pieces when mutilation occurs.

In an analysis of the study of the human masticating mechanism, three questions present themselves:

1. What is the full function of the human masticating machine?
2. What is the highest type or norm or standard by which the various masticating machines can be measured and classified?
3. What types of unbalanced occlusion will such a norm disclose?

In seeking to answer these three questions, we must study the developing occlusion from its beginning, just as the researcher in embryology and developmental anatomy learns from a study of the developing individual from the very beginning. The many factors at work during the developing years, the combination of which produces the final result in jaw and tooth relationship, have received careful consideration, especially by the orthodontist. These factors or forces must be thoroughly understood if one is to get the full meaning of any particular type of occlusion under observation. Normal functional forces correctly applied during the developmental years, other factors being equal, should produce a correct occlusal relationship. In the term force or factor is included hereditary influence, biting forces, lip and tongue habits, the presence of abnormal tonsils and adenoids, premature loss of teeth, nutritional disturbances and correlated functional disturbances.

What is the full function of the human masticating machine? We first think of the act of chewing food in order that growth may be produced and life maintained. Scientific literature is full of discussion concerning the value of thorough mastication of all foods in order that complete nutrition may result. It is true that there are physicians and dentists who seriously question the need of such complete comminution of foods or even the necessity of eating the type of food that requires thorough mastication. By far the larger number believe that the diet should include foods that must be thoroughly triturated to be of the utmost value in the body economy.

But it appears that mastication is not the entire function of the organs represented by the teeth and jaws; for the orthodontist and the ear, nose and throat specialist have learned the close interrelation of the anatomic parts that come under their observation and care. That is to say, a deformed jaw relationship in the growing years of childhood is associated with and no doubt influences deformities in other head and neck areas; for example, the air passages. Muscle pull on the various bones of the cranium, by a normal and vigorous chewing action, should result

similarly to muscle pull by exercise in other parts of the body. Going farther with the simile: we should not expect full function of muscles attached to deformed bones in other parts, so why look for full function of muscles in cases of deformed tooth and jaw arrangement? Because of this fact, the unrestricted jaw movement demands the highest degree of harmony of all working parts. The more nearly perfect the jaw and tooth relationship, the more nearly ideal will be the formation of the head and neck, other factors being equal.

What is the highest type or norm or standard by which the various types of masticating machines can be measured and classified? Quite a number of definitions of what constitute a high type jaw and tooth relationship have been presented from time to time. As we survey them all, carefully trying to visualize just what the author has in mind, there seems to be a lack of tangible essentials about most of them. One author will emphasize certain phases or features, and others will lay stress on something else. It seems needless to assert that we can get nowhere in a study of this intricate problem without having clearly before us a type of masticating machine that all agree is the standard or norm by which the cases in everyday practice may be judged. This point deserves serious consideration, and while it might seem, on first thought, to be impossible to obtain a uniformity of opinion on such a question, the effort should be made; for, as we study the situation, it becomes more apparent that the future of dentistry depends in a large measure on a common decision as to what to use as a standard of measurement in occlusion. To reach a decision as to what constitutes a standard, we must first have a comprehensive knowledge of the many fundamental factors involved, and coupled with such knowledge there must be a genuine desire to contribute something more noteworthy in service to our patients than has ever been done. In this paper, there will be no attempt made to solve the question as to what constitutes a norm in occlusion, but I hope to present enough points of view that we may all be induced to greater effort to determine the best type of tooth and jaw relationship.

When we think of the human masticatory organs as a machine, we naturally think of this machine in action, or physiologic function. As stated before, this idea of a machine in action appeals to nearly all dentists because of a fairly common understanding of mechanics. In the masticating machine, we see a base, the maxilla in which should be embedded either ten or sixteen gears, the teeth. Opposing this base is a horseshoe-shaped device, the mandible, around the periphery of which should be ten or sixteen gears, or teeth. We are all agreed that if this much of our machine is correctly constructed, the putting together of the two devices just described will reveal a locking or interlacing of the gears or teeth. In this position, before any action takes place, the combined relation of upper and lower teeth and osseous structures provide a relationship around which all of the associated parts of this machine are correctly located, each positioned to enter best into the complicated movements for which the machine is constructed. If these gears or teeth are of the right length and are correctly opposed, then and then only can the contiguous parts take their correct position and function properly. The reason for stressing this point so strongly is the

apparent lack of its consideration when occlusion is discussed.

To state the point differently: the teeth in contact in a position of central occlusion act in a similar manner to the stop placed by the carpenter after hanging a door on hinges. Either the lower jaw or the door would go by the place of correct stop if the stop is not in place, thereby altering the true action and purpose of either device.

As this machine is being planned for complicated action, it becomes necessary to incorporate balancing points to work in harmony with the gears. These balancing points or the total balancing contrivance we know as the condyles. Apparently, the condyles, in their paths are not expected to take any of the load from biting stress when this machine is functioning, but are to provide delicate balancing devices for this extremely intricate machine. Observation of large numbers of skulls reveals the fact that when the occlusion and condyles no longer present a harmonious relationship, to the extent that the actual load is placed on the condyles during mastication, there results a deformity of the condyles, which seems to be one evidence that the occlusal surfaces are intended to be the load carrier.

If the total relationship is harmonious, the teeth in occlusion are the guiding or controlling factors rather than the condyles. The problem may be considered in two ways: 1. The individual sometime in life, and for some unknown reason, acquires deformed condyles, and this deformity in time causes malocclusion. 2. The occlusion becomes inharmonious for reasons that can be seen and understood, and this occlusal unbalance in time causes deformity of the condyles.

Here again is the evidence that we can solve the problem only by a study of the developing individual, for such study indicates that condyles are deformed only because of Nature's compensation to an unbalanced relationship.

As we proceed further with a description of a tooth and jaw relationship that may serve as a standard, we should be reminded that whether in the deciduous tooth age or the adult, we have in mind a full complement of teeth. Assuming that the upper and lower parts of the machine, as described, are in correct position, one against the other, with beautiful intercuspation of teeth, the balancing contrivance, the condyles, in harmony with the occlusion, the muscles as motor power awaiting the impulse to act, we must be ready to observe just what takes place when action begins. Of the two principal movements, the opening and the triturating, we shall consider the latter at this time.

As the need for masticating food sends the energy to the source of power, the muscles, we can observe whether there is straight open and closed movement or there is an effort toward keeping the gears or teeth together in a grinding or sliding movement. If the machine is as well constructed as we have tried to point out, there will be a continuous sliding, grinding contact of the occlusal surfaces as the mandibular teeth execute lateral excursion, maintaining intercuspation or meshing of gears, with no disharmony of cusps to interrupt the maximum sliding contact. Along with the meshing of cusps, there is observed one other essential point: occlusal contact on the working side and, at the same time, maximum contact on the opposite side. This is our conception of balanced occlusion and,

as such, it becomes our standard or norm by which all occlusion is measured.

As we study all the definitions for a normal, an ideal, a balanced or a correct occlusion, we see much of an intangible nature; but there are two absolutely tangible and essential attributes of an ideal, or balanced, occlusion. They are, first, intercuspation during triturating movements, as in central occlusion, and, second, maximum occlusal contact on both sides of the arch simultaneously during the same triturating movements. Many thinking of these two points for the first time will agree as to the presence of these attributes, believing that there could be masticating function in no other way. To you who have never observed occlusion with these two points in mind, I suggest that you begin at once to search for such a perfect type. A diligent search will satisfy one that we do not have many such ideal arrangements any more, and, at the same time, there will be revealed how the various types that do not measure up to the standard do obstruct true and free masticating function, in some cases even causing serious deformities and disturbances in other parts of the head and neck.

There need be little argument as to just what name to give to the highest type of tooth and jaw relationship. We can each of us choose any name or term that suits best, provided we actually have a conception of perfect or ideal occlusion in mind. Dental literature contains many articles wherein the authors describe correct tooth and jaw arrangement, each using a term that best explains his idea. One will choose "normal occlusion;" another thinks "ideal" is the right expression; while still another will present "balanced occlusion." Except for the fact that, whenever possible, terms should be used that give the exact meaning of a condition, the name makes little difference. The matter of greatest importance is that we all have exactly the same conception as to what constitutes a norm or standard in occlusion, for the purpose of judging the occlusion we see every day and for the purpose of rendering the expert opinion expected by the patient. To depict a high type of occlusion, I believe that the term "balanced occlusion" is expressive of what I have in mind.

In visualizing this balanced occlusion, it is necessary to keep constantly in mind the biting forces that are manifest when the masticating machine is in action. Dr. G. V. Black measured these forces and found that stress up to 300 pounds was a possibility in the bicuspid and molar region. We must also think of what receives the stress for the biting forces; in other words, when we look at the masticatory machine in action, we should be concerned most of all with the direction and distribution of the impacts of one jaw against the other. In making a decision as to whether the teeth are taking the load correctly or not, think of a stick driven into the ground. Blows from a mallet in the direction the stick stands will have little effect on the material in which the stick is imbedded, but any blow delivered at any other angle than in line with the long axis will cause a breaking down of the material surrounding the stick.

How can we expect masticating forces to be directed against the long axis of teeth when the principal movements are from side to side or laterally? This question arises especially in cases presenting steep angles and long cusps.

An eminent periodontist in a recent

paper states that, in his observation, vertical stress on a tooth is less harmful than side or lateral stress. He advocates the grinding of long and steep cusped teeth to make a shorter and a more obtuse angle. This example of the prevalent method of examining occlusion is to be deplored, for it considers only one side of the mouth at a time. It is true that, in the type mentioned by this writer, there must be undue lateral stress on the working side; but this is not due to the long or steep cusps, but is a result of a lack of full and harmonious development, with a resultant lack of balance and of support of the working side from the opposite side; that is, if there were balanced occlusion there would not be undue side or lateral stress, for the reason that the total occlusal surfaces would be taking the load rather than one side alone.

The significance of a correct distribution of forces is further illustrated in the work of the orthodontist by a case that has been dismissed as completed, with an apparently good result, but which in a comparatively short time returns to the original disharmony. Usually, when this occurs, the reason given is that the retaining appliance was removed too soon. The careful thinking orthodontist is becoming more and more certain that his real task is to so regulate his case that, when it is finished, the balanced occlusion, which means a correct distribution of applied forces, will maintain itself without any retaining appliance. And further, if such a norm is not reached, no retaining appliance will prevent a return of some degree of the original malocclusion.

All of these opinions in the profession illustrate the significance of the lack of understanding as to what constitutes balanced and unbalanced occlusion. Occlusion is either balanced or unbalanced, and malocclusion, traumatic occlusion and the like are the result of unbalanced occlusion.

The important point, then, if we agree that definite forces are at work during mastication, is the manner in which these forces are received and taken care of by the teeth and jaws. This, I believe, is the foundation upon which all conceptions of a standard of occlusion must be based. Is it necessary to have a certain tooth and jaw relationship in order that the applied forces of mastication will be equally distributed, or will any arrangement of teeth provide for the stresses without giving evidence of harmful results? This question has been thus answered to my own satisfaction by careful observation over a period of several years: there must be a certain definite tooth and jaw relationship, insuring that the teeth take the stress of mastication on their long axis, and in addition the occlusal relationship must be such that the patient cannot find a position in which only a few teeth are in contact.

With a clear conception of balanced occlusion in mind to be used as a norm, to place beside all cases, as we are called on to decide the question as to whether there is something wrong or not, we have the possibility of accumulating evidence about balanced and unbalanced occlusion.

In deciding what to do with the cases coming under his care, the orthodontist has found that a classification of conditions and causes for such conditions is of value in determining what type of treatment to follow. The classification used by the orthodontist is here given in abbreviated form.

CLASSIFICATION OF CASES

Class I or Neutroclusion.—First molars are, as a rule, in correct mesiodistal relationship. The malocclusion or deformity evidenced in this type of case is the result of a general lack of development of the maxilla and mandible. There is a crowding of part or all of the anterior teeth. A common example of this type is the case showing lack of space for the upper cuspids, the cuspids erupting high and outside the established arch. As a rule, a more or less constricted arch accompanies the crowding and rotating tooth condition.

In looking for the reasons for the need of correction in this type of malocclusion, the orthodontist tells us that two things are important: 1. If the case remains as described, the forces applied in mastication must, because of the position of the teeth, inhibit further development of the boney structure; in fact, the line of force, directed, as it is, in any direction except the long axis of the teeth, is constantly driving the teeth away from a correct position. 2. This inhibition of full osseous structure development results in some degree of breathing interference as the lack of jaw development influences nasal space.

Class II or Distocclusion.—The lower arch is distal from the position assuring a correct relationship with the maxilla, or, as stated by some orthodontists, the lower first molar is in distal occlusion with the upper first molar. The orthodontist gives, as some of the reasons for correcting this condition, the fact that the stresses of occlusion, being all in the molar region, there results lack of vertical development of bone and teeth, a retardation of the growth of the mandible and an overdevelopment of the maxilla. We are told that if this condition remains uncorrected, the misdirected forces of occlusion will actually tear down the masticating units, causing loss of teeth much earlier in life than if the malrelationship did not exist; also, that the health of the patient will be affected.

Class III or Mesiocclusion.—The lower arch is mesial to or in front of a position assuring a correct relationship with the maxilla, or the lower first molar is in mesial occlusion with the upper first molar.

Here, again, we have occlusal forces constantly at work against correction. There must be a great deal of masticating inefficiency, and, as in all types of malocclusion, the forces applied through mastication, when not applied on the long axis of a tooth or teeth, will tear down the mechanism.

Along with the classification, you will observe that there has been included a few of the reasons for changing or correcting whatever type of malocclusion is present. The orthodontist has for several years called on the dental profession to observe these unbalanced conditions in the mouths of the child patient, and has pointed out the necessity for early recognition and early treatment that advantage may be taken of developmental assistance. To some extent, all dentists agree with the orthodontist, but few can boast of a thorough knowledge of malocclusion in children. Whatever the degree of understanding of the child tooth and jaw relationship, why limit the observation to children's mouths and complacently ignore identically the same conditions in the adult? There is no need of debate concerning the inadvisability of treating like conditions in the adult in the same manner or by the use of the same instrumentation as in the child's case. The impor-

tant thing is to recognize similar conditions and to know the significance of each to the health of the patient and to the function of the masticating machine. History shows that development of methods for accomplishing any certain thing follows quickly on the understanding of what the thing is to be accomplished.

Following the plan of the orthodontist, we shall present three main types of unbalanced adult occlusion. Many modifications can be found, and the larger the number of investigators who are placing an ideal of balanced occlusion beside every case that comes into the office and recording the degree and manner in which such cases are different from the norm, the more complete will become the classification. The classification here presented is the work of Drs. C. K. Bird and O. DeForest Davis.

CLASS I. Overbite and Overjet Types.

(*A*) Presents marked overbite, but little overjet. This type of deformity originates in a nearly ideal; and, through excessive wear or loss of teeth, shows considerable closure. There is pronounced wear in the upper and lower incisors, and very often the remaining posterior units, especially the bicuspids, are intruded, owing to excessive and unbalanced stress.

(*B*) Presents marked overjet and overbite. This type of deformity is usually due to lack of development of the mandible, which in turn constricts the lateral development of the maxilla. Usually, little wear is shown, except on the second molars.

There are combinations of deformities with characteristics of both subdivisions, which may eventually need further classification, but for the present they will all be included in Class I.

CLASS II. Prognathous Types.

(*A*) Congenital and developmental. Through hereditary influence and improper development, a prognathous condition may be produced in a child, which, if treatment is not instituted, is perpetuated as chronic in the adult.

(*B*) Acquired. A prognathous condition may be acquired through wear, excessive function and loss of teeth, even though the condition before mutilation was nearly ideal.

CLASS III. End to End Types.

Presents with vertical closure only. Always shows excessive wear. Normal arch form maintained, because the lines of vertical stress are usually unimpaired.

Any of these types may present deflection of the mandible from the median line due to excessive function unilaterally.

When making a careful study of this classification, and also when observation is made of occlusion in the mouth, there are four important points to keep in mind.

1. The statement is made that in subdivision A of Class I, the condition originates in a nearly ideal. This calls for accurate knowledge as to what constitutes an ideal in human occlusion. The beginning of deformity in this class is often deceiving, in that where the original condition is ideal or nearly so, the change is due to a loss of essential anatomic contours, especially the occlusal. In some cases, this loss of shape, due to wear, is very rapid; while, in the majority of cases, the change is gradual and difficult to observe until a degree of change has taken place that is unmistakable. Extreme care is necessary, therefore, in analyzing a case, not to overlook a relationship which may seem a perfect occlusion but which, on closer observation, gives evidence of mutilation. Close observation in the mouth, the patient being instructed to

move the mandible laterally and forward and back, will reveal certain discrepancies. It will be noted that maximum occlusal contact is possible in central occlusion only. As the patient moves in sliding occlusion, the lack of complete balance can be seen, and although sometimes apparently slight, the longer it continues without treatment, the more pronounced will be the unbalance. The resultant damage is due to the fact that the applied forces of mastication are no longer directed against the long axis of the teeth, and unless the investing tissues are unusually resistant, there will soon be a pathologic process present.

2. By far the larger number of cases are of the extreme overbite type. As trouble makers for the patient and dentist this type takes the lead. Restricted mandibular movement with the teeth in occlusion is first observed, and, as the case continues, there appears a pathologic process of the investing tissue, and probably tongue, throat and ear disturbances. To the dentist thinking only about whether or not his restorative work will remain in the patient's mouth, this overbite type is a source of never-ending worry.

In order to discuss overbite cases properly, we should first understand the difference between a correct and an incorrect overbite. By correct overbite I mean a condition wherein the teeth in central occlusion present the same proportionate overbite in the biscuspid and molar region as in the anterior tooth relationship; that is to say, if the patient moves the mandible forward to an end to end bite, the tips of the cusps of bicuspids and molars will be in contact, or in a balanced occlusion in the forward range. Any type of anterior overbite that presents contact of the anterior teeth only, with space between the bicuspids and molars, when the mandible moves forward to an end to end bite, is classed as an excessive or incorrect overbite. We believe that this condition of excess overbite deserves more consideration from the dentist than it has received. This type shows a variation of all degrees from the correct or balanced type, and there are many problems that result from whatever degree or type of excess overbite is present.

The cases that present with the occlusion on the working side in lateral position during mastication, taking the whole stress of the biting force, are prevented from having contact on both sides, or a balance in lateral range, because the overbite in the anterior region is greater than in the posterior. The fact that the mandible travels in an arc when lateral movement occurs throws the anterior teeth into contact in every chewing range. Obviously, the greater the overbite varies, anteriorly and posteriorly, the more difficult it becomes for the patient to produce occlusal contact on both sides and the anterior part of the arch at the same time.

No satisfactory answer has been given as yet to the question as to why any type of excessive overbite appears or develops. Some cases are easily understood; for example, that type developed because of a loss of posterior teeth, producing a shortening of the jaw relationship. Whatever the cause of any excessive overbite condition, there appears to be a lack of vertical development, either of teeth or bone, or of both.

We believe that the orthodontist and the dentist in general practice may look for some of the reasons for failures in

treatment, whether orthodontic or reconstruction, in this overbite condition.

3. The overjet type in the adult is similar to the Class 2 type as given to us by the orthodontist for the child occlusion. The lower arch is distal from a position of correct relationship with the maxillary arch, and the space between the lingual surfaces of the upper anteriors and the labial surfaces of the lower anteriors is known as overjet as distinguished from overbite. As stated in the adult classification, this type is the result of lack of development of the mandible, and, by the same token, we can include overdevelopment of the maxilla. The forces of mastication, which are chiefly exerted in the molar region, are directed forward on the upper, and the counter force is exerted backward on the mandible.

The acquired type of overjet case may be the result of loss of lower first molars, in which case the lower second molars move and tip forward and inward as do the third molars when they erupt. The upper first molars gradually elongate, and eventually the distal cusp of the upper first molar occludes with the mesial inclination of the distal cusp of the lower second molar. The result of such an occlusion is a driving force forward on the upper arch and a driving force backward on the lower arch. Crowded or protruded upper anterior teeth and a more or less chinless appearance are the result, together with a pathologic condition of the investing tissues and probable ear and throat disturbances.

4. The prognathous type, for the adult, corresponds to Class III for the child. The mandible is in mesial relationship with the maxilla. The significant point in this type is that the direction of forces is exactly opposite to what obtains in the overjet type. Whereas, in the overjet case, the mandible is in distal relationship to the maxilla with the biting forces in the posterior and the direction forward, in the prognathous type the mandible is in mesial relationship to the maxilla, with biting forces in the anterior region and the direction backward.

This fact is worthy of careful thought because, in each condition, this direction of force, unless corrected, is continually at work making the condition worse. In the distal occlusion type, the maxillary teeth are being forced forward and the counter force is forcing the mandible backward. In the mesial occlusion type, just the opposite condition is present, the lower jaw being out in front of the upper, the resultant forces tending to drive the upper arch backward and the counter force to drive the lower forward.

Surely, there can be no argument as to the need for correcting any of the types herein outlined. We are becoming more and more aware that our efforts toward preventing and repairing loss of function of the masticating machine are being questioned by patient and dentist alike. My plea is for a more comprehensive study of the machine. Let us throw off the shackles of preconceived ideas and discard some of the theories that have come down through the ages as law in diagnosis and treatment.

There will be no attempt to present specific technical detail for treatment of unbalanced occlusion. Such technic is already available as far as it has been successfully evolved and put into operation. Here again, we need the assistance of a large number of those in the profession in applying certain principles correctly until greater accuracy is ob-

tained. As we study our cases, it becomes obvious that correction of unbalanced occlusion resolves itself into a problem of producing balanced occlusion. Not whether the tooth restoration of such correction shall be gold or porcelain, removable or fixed bridgework, one type of partial denture attachment or another, but first a decision as to what to do about the entire tooth and jaw relationship. With a clear picture of a high type or balanced occlusion in mind, the operator can work out the details of each tooth restoration to suit himself, always thinking of the finished case, which must correspond with the norm or standard. Since correction of unbalanced occlusion has, as a part of the process, the opening of the bite, there is in the minds of many the idea that opening the bite is the principal part of the operation. As a matter of fact, opening the bite, while entirely necessary, is only one step in the process of correcting unbalanced occlusion. It may be well to remind you that if opening the bite is an essential part of the treatment, surely grinding, in an unbalanced occlusion, will not produce a balanced condition.

What may we point out as being of value to us as we go back to our practices? It seems to me that the principal good might come from a consideration of a need in dentistry for measuring things or conditions. We all are constantly analyzing everything about us, from the standpoint of how one thing compares with another. Holding an object in the hand and trying to judge anything about it is a waste of time unless we consider it in relation to another object. Judging a diamond means merely a comparison of one stone with another stone that the judge considers the ideal or perfect diamond. The better conception a judge of diamonds has as to what constitutes a perfect diamond, the better judge he is. The dentist's task is the care of the oral cavity, of the machine with which mastication is accomplished; in other words, the total mechanism. Then why quibble about fillings and reconstruction pieces before we comprehend this ensemble, before we find a standard of measurement or norm by which you and I and all dentists determine what is out of tune in all the cases we see? Surely, our mechanical geniuses in the profession will have better luck with many of the contrivances that they invent for us if they and we first agree as to what it is we are attempting to do for the patient in relation to a standard. We might even get to the point of attributing our failures to a lack of knowledge of the fundamentals of jaw and tooth relationship instead of to the use of some type of attachment, *et cetera.*

There could be no bigger, better service on the part of this section than to map out a comprehensive program by which a large number of men all over the world could be gathering material, to be shown each year at the annual session of the American Dental Association, to the end that, eventually, there would be a common understanding in the profession as to what constitutes a balanced or an unbalanced occlusion.

DISCUSSION

A. Alfred Nelson, Detroit, Mich.: I regret that Dr. Washburn has not given us a definite procedure for the correction of unbalanced "adult" occlusion. The sum and substance of his paper, aside from the details, explanations and similes to bring out his interpretations, is a plea for the profession to come to some understanding or coordinated opinion as to: (1) how to judge what should be

done; (2) what means should be employed to determine this judgment; (3) how to gain a better conception of combined problems to be considered in the care and treatment of the masticatory apparatus. The leaders of work in our field have been divided by two different conceptions or interpretations of the fundamentals involved in our problem. To quote from a recent publication by Dr. House of Kansas City,[1] "At the very beginning of treatment the dentist places himself in one of two distinct groups of workers. One group disregards all of the changes which have taken place in the forms of the natural teeth, in mandibular functions and in the articulating joint. These workers believe that the cusp forms of the teeth and the way in which the teeth are arranged control the movements of the mandible and that they may safely arrange artificial teeth by an arbitrary technic without regard to what the habitual movements of the individual patient may have been. They believe that by such a technic they can establish an ideal function which will result in comfortable and efficient mastication. Long experience and extended observation clearly demonstrate that the efforts to establish ideal function without regard to asymmetries of horizontal movement, which may have developed in the individual and been continuous for years, result in continuous cuspal interference between the maxillary and mandibular artificial teeth which cannot be corrected without extensive grinding away of the cusps. This interference, unless relieved, causes continuous soreness of the soft tissue and destructive changes in the underlying bony structure. In an unsuspectedly large percentage of cases interference of this character accounts for the continual grinding of teeth and frequent rebasing of dentures, which are resorted to in the search for relief. The other group of dentists attaches a very high value to the changes of the forms of the teeth which occur in the patients prior to the making of artificial dentures, to the changes in function which result from the changes in tooth forms and to the changes in the articulating joint which result from changes in tooth forms and in function. They believe in recording the mandibular movements habitual to the patient, in diagnosing the character of those movements and in arranging the teeth in such way as to reestablish proper facial dimensions and the cuspal interdigitation and coordination necessitated by the mandibular movements habitual and peculiar to that person. Experience and observation show that arrangement of the teeth in this manner obviates the necessity for extensive grinding away of the cusps and frequent fitting of the denture, and reduces the soreness of the soft tissues and the destruction of the underlying bony tissues to a minimum." What Dr. House states in reference to full denture problems can be applied with equal emphasis to the problems of partial denture. In the first group might be placed such investigators as Bonwell, House, Hall, Campbell, Monson, Needles, Wadsworth, McCollum, and, to judge by previous publications, Dr. Washburn. The latter group of investigators embraces such men as Walker, Gysi, Prothero, Frahm, Horner, Kerr, Hanau, Tench, Wright, Gillis and Sears. Lately, Needles, Campbell and House have joined this group. The theories represented by these two groups were the source of the controversies of yesterday. As matters stand now, it may be safely said that our keenest thinkers and investigators have definitely alined themselves with the latter group. We may safely presume that the basic principles appertaining to balanced occlusions are now fully understood and ready for application, though there may still be some disagreement on minor points. The science pertaining to balanced occlusions, balanced jaw relations and balanced articulation is an exact science today, just as exact as are physics and chemistry. As in physics and chemistry, we will have further developments and progress without any immediate need of revolutionizing basic principles.

Do not think for a moment that I have forgotten myself by embracing, for any ulterior motives whatsoever, some new articulator religion; and don't assume that I possess that analytic mind of a genius who can decide on theory only. My decision has been arrived at after expensive and discouraging failures and hard study, and by observing others achieving satisfactory results where I had formerly fallen down. There was nothing left for me but to renew my efforts and do better. I would suggest that those in a position such as I was do likewise, for there is no further excuse for leaning on faith to decide an issue on balanced occlusion, etc.,

1. House, M. M.: Dent. Digest, September, 1925.

as has been the vogue. As regards the four outstanding points to which Dr. Washburn refers: "There seems to be a pronounced change of thought among the leading investigators *from* a consideration of individual teeth or spaces *to* a study of all associated structures involved in the function of mastication." Recent teaching and research has been going on for some time with the thought that each operation in the mouth should be so devised and carried out as to leave the mouth and adjacent structures in the most favorable condition possible. This proves that we have for some time been considering our problem in its entirety, and the coordinated relationships of individual restorations and operations, with due regard for the most beneficient results as a whole. "There is now a realization that no one person can in a life-time solve dental problems and produce a device for replacing all types of lost tooth areas." It is unfortunate that this statement was put into one sentence, because the first part is a very safe opinion, but the second and important part is an opinion which we should question. Logically, a device that would qualify for replacing any one type of the lost tooth areas and was constructed on the qualifications as set forth in the answer to the first point must be in compliance with certain fundamentals to which the restoration of all lost tooth areas must conform. Therefore, the type of area lost interests us only as far as we can restore it in harmony and to the benefit of the adjacent and correlated parts. Therefore, the restoration with which we are primarily concerned must be made in harmony with this coordination, and if this can be done with any one type, it can be done with them all; for any kind of restoration can be varied into compliance with these requirements. By way of illustration, say we may use a device that will detect cusp trauma. This device could be employed in operative, prosthetic or periodontic work, regardless of what type of tooth area was being restored. "Dentistry is demanding comprehensive research in addition to what is being done along bacteriologic lines, research dealing with the fundamentals of jaw relationship." If dentistry is demanding comprehensive research, it should at least consider what has already been laid before it. Comprehensive research is indeed vital to our progress, but have we as yet advanced to the point justified by research already done? If so, our demand is well made; if not, further research loses much that it might give. "The periodontist, through keen observation, careful study and large experience, is pointing out the similarity of the problems confronting the orthodontist and prosthodontist." This we have already answered in reply to the first point. While the type of our work differs, the fundamentals of correction are identical, be it a filling, a crown, a plate, a bridge or a prophylactic treatment. While there is much to be found out in regard to the physiologic function of the masticatory apparatus, the mechanical function has been clearly worked out. That the physiology is far from being clearly conceived was evidenced by a recent paper read by Dr. Tom Smith in Los Angeles, who has been lecturing on the pathologic relationship between the masticating apparatus and the auditory apparatus. Dr. Smith asserted that impairment of hearing was caused on the side from which the teeth had been lost owing to the pressure by the condyle on that side. If we consider what takes place in this condition in regard to jaw movements, we will see how this inference might be incorrectly made. In regard to types, norms and standards: These, as Dr. Washburn has stated, may be used for classifications. But for the purpose of correcting "adult" occlusion, which is the subject of his paper, these norms and standards cannot be indiscriminately applied, as is being advocated. We must build to conform to individual requirements for the best results under the conditions with which we have to contend, and these cases in rare instances will approximate the ideal. The requirements are governed by partly unchangeable existing conditions, which do not permit of strict conformity to any type, norm or standard. There are several factors that enter into the control of the occlusions. Whether there is a predominance of any one of these factors, such as the teeth, is an open question. In the consideration of this problem, Dr. Washburn says: "The individual, some time in life and for some unknown reason, acquires deformed condyles, and they, in time, cause malocclusion," in referring to deformity of the condyles as a cause of malocclusion. Now, if the teeth were the controlling factors in occlusion, how could the deformity of the condyles, which had resulted from some unknown cause, produce malocclusion, unless the effect of condyle formation was more

potent than the teeth in occlusion? The question of tooth control in movements of occlusion is a conception similar to that of the floating theory, discarded some time ago by previous investigators. Dr. Washburn likens the anatomic apparatus to a machine of the gear type, in which the teeth are represented as the gears. He also says that this machine is being planned for complicated action. Now the most important point in regard to the operation of machinery is purely mechanical, and, in this respect, it is well to call attention to the two factors that are continually being confused when comparing anatomic and mechanical apparatus. In the anatomic machine, the development of the various parts does not concern us in considering function only. Our preeminent consideration is the parts already developed, just as in applying gears to machinery. The method by which the gears were developed or made is secondary as long as they conform to definite specifications. Likewise, our study and development of the anatomic apparatus cannot help us any too much in the understanding of the complicated action of the fully developed parts. It seems more logical to study the developed parts individually and collectively in their coordinated relationship to the mechanism as a whole if an analysis of their mechanical function is the object. In studying our problem in this way, the complicated action, which the essayist refers to, is a study of motion. This study is known as the science of kinematics. Kinematics was introduced into dentistry as such by a recent investigator, not a dentist, who after obtaining a comprehensive understanding of the work of many previous dental investigators approached the problem from a purely mechanical standpoint. This investigator had many advantages over purely dental investigators. In the first place, he separated physiology from mechanics. We can only appreciate what this means when we realize that the jaws in motion present a purely mechanical problem, and that when the mechanics is corrected, the physiology or function is also corrected, according to our present understanding of the subject. In this regard, we are indebted to this investigator for definite laws of articulation governed by the kinematics involved. The application and proven results of these laws have advanced our problem far beyond a study of the purely developmental stage of the parts involved. Dr. Washburn's suggestions and conjectures in regard to occlusions, balances, angles, stresses, forces, points of application, etc., are all contained or can be answered in the combined works of Gysi and Hanau. To discuss these points now would be an anachronism. The orthodontic consideration reviewed by Dr. Washburn are interesting as a résumé of the points of view of various orthodontic schools. The latest conception of orthodontics is that of Simons, being translated into English for publication in this country by Dr. B. E. Lisher. Another conception by a recent English writer, John S. R. Heath,[2] L.D.S., R.C.S., advances an entirely different theory regarding some of our malformations from an orthodontic standpoint, attributing such malformations or abnormalities to the repression or expression of the sexual life of the young child before puberty. His line of reasoning is similar to that of Freud. He cites competent authorities, and states that the so-called adenoid face, the narrow, deep palatal arch, the irregular eruption of teeth are not due to a simple mechanical cause, such as the presence of abnormal tonsils and adenoids. He says: "We are dealing with an arrest or disturbance of the elaborate mechanism which underlies facial growth. Evidence is produced that this mechanism is influenced by the functional state of the pituitary and sexual organs." The authorities he cites for this statement are Sir Arthur Heath and Champion, from their book "Contributions to the Mechanism of the Growth of the Human Face." In the face of these and similar contrary views among orthodontic authorities, it seems doubtful that we may, at this time, reach out to orthodontia for reliable information, especially as concerns the mechanics of occlusion. That they as a body are just as little enlightened in this respect as is the average prosthodontist is also evidenced by their divergence of interpretation of etiology and treatment in the different schools. Dr. Washburn, in his deliberations, mentioned a case of failure of orthodontia and the usual incorrect reasoning for the failure that invariably follows. He also stated that "the careful thinking orthodontist is becoming more and more certain that his real task is to so regulate his case that when finished the

2. Heath, J. S.: Dent. Cosmos, September, 1925.

balanced occlusion, which means a correct distribution of applied forces, will maintain itself without any retaining appliance, and further, if such a norm is not reached, no retaining appliance ever invented will prevent a return of some degree of the original malocclusion." I hope the orthodontic specialists will mull over that statement of Dr. Washburn. It is true that some of them are certain that a change in treatment is due, but as yet few have approached the subject from the proper angle. For the past three years, I have advocated and have worked on the subject of orthodontic treatment on the basis of first establishing the jaw relationships as they exist in the patient, and by means of the face-bow and records, transferring them to an instrument that will allow of condylar path adjustments. In other words, I reproduce in an instrument the error or errors that exist in the patient. Then, and only then, am I qualified even to hint at the correct procedure for treatment of the case in hand. Effort has been made to interest members of the orthodontic profession, but with scant result. However, one of those consulted has evidenced a keen interest and the results are highly gratifying in the treatment of his cases. While on this subject, permit me to deviate slightly and state that our next greatest step in preventive dentistry will be the correction of unbalanced occlusion of the permanent teeth in the young child, those occlusions that today are not considered orthodontic cases. In concluding, Dr. Washburn suggests, as a point of outstanding value, the great need in dentistry for measuring things or conditions, and also that there should be an annual meeting of the American Dental Association to the end that a common understanding may be arrived at. Before this can be done, we must choose between the lines of work in our field as represented by the two groups previously mentioned in the beginning of this discussion. It would be unfair to either group, or to ourselves, to revert to some common point in the past, to rehash basically sound fundamentals upon which our present status safely rests. Progress is ahead of us, not in the past. Here my opinion differs from that of Dr. Washburn, and I should like to suggest that instead of going back to and parking at the study of developmental stages only, we should also familiarize ourselves with the evidence, in both clinics and papers, presented here at this meeting. Let us compare the results of the clinicians as presented here, and then let us go onward to a greater understanding based upon the best results obtainable with our latest knowledge. This, to me, would seem the most logical method to pursue, as it offers most rapid development for the increasing number of problems that are being continually presented to us. Basically, the problems of balanced and unbalanced occlusion in full denture work are closely akin to those of crown and bridge and partial denture work, and hence, because of this kinship, it is incumbent on us to study thoroughly the problems as they have been advanced in full denture construction and, on this basis, work out our peculiar problems.

F. W. Frahm, Los Angeles, Calif.: I think the title was an unfortunate selection, and the presentation of the subject pedantic. Malocclusion would have expressed more accurately the thought, and would clear up many of the arguments and theories presented. It would also make plain some of the diverting and confusing contentions, and give us a hopeful prospect regarding the solution of our occlusion problems. The contention that the profession is losing patience with the technical types of discussion that give us nothing of a fundamental character is not well taken. Our profession, in fact all professions, have a technical background and foundation. Without these, there would be little of value to be discussed, and our deliberations would be uninteresting and impractical. We cannot separate technic from theories, any more than we can separate thinking from living, without producing an idiot. Likewise, theories in the abstract will produce professional morons instead of scientists. Thinking it through and working it out on the anvil of our daily practice will justify our mode of practice and establish it. In the closing paragraphs, Dr. Washburn says: "There will be no attempt to present specific technical details for treatment of unbalanced occlusion." Continuing, he says that we already have it, and in the next breath, makes an appeal for larger numbers to come to our assistance to help solve the problem, and throw off the shackles of preconceived ideas. I have carefully read the paper several times, and must admit that no effort has been made to give us any ideas or methods that may be employed for the correction of this phantom thing, named "un-

balanced adult occlusion." Let me ask, what is unbalanced adult occlusion? And, if you should be privileged to see a case, how long would it exist as such? An unbalanced condition of the masticating machine of the adult, or any other, does not remain in such a condition for any length of time. Nature will compensate in one of several ways and establish balanced functional occlusion. Dr. Washburn states that opening the bite is entirely necessary, and the first step in correcting such a condition. Those who have "opened the bite" at any time will remember the grief they and their patients have experienced by the process, and the unsatisfactory results. Opening the bite, or the intermaxilomandibular distance, should always be accomplished by degrees, and with careful regard of all factors that are involved. Dr. Washburn says that a correct distribution of applied forces will maintain the teeth in their normal position and prevent a return to malocclusion, and he states: "The important point, then, if we agree that definite forces are at work during mastication, is the manner in which these forces are received and taken care of by the teeth and jaws. This, I believe, is the foundation upon which all conceptions of a standard of occlusion must be based." I am convinced that the teeth and jaws do not take care of any force, direct or indirect, or applied. They are compelled to coordinate by movement of shifting or wear in the adult, and by changed development and migration of teeth in the person undergoing development. Teeth will move into or out of functional alinement, in spite of our efforts to curb them. In visualizing balanced or functional occlusion, we must account for three lines of stress, direct, indirect and torsional. When the patient is simply occluding the teeth, the stress exerted by the muscle unit is applied along the long axis of the teeth and is of little concern to the operator, with the one exception of the incising function, when the impact is directly on the incisal edge. I would like to emphasize the fact that our occlusion problems are not embryonic, as Dr. Washburn would lead you to believe. It would be wonderful if we could enter at that time, outline our plans and establish a perfect relationship of all the parts that are involved. Has any man here ever seen an irregular and unbalanced deciduous occlusion? In speaking of the balancing points working in harmony with the gears or teeth, Dr. Washburn says that, apparently, it is not expected that the condyles, in their paths, will take any of the load from the biting stress. This is a physical and anatomic impossibility. And if we have any loss of the molars, the condyles must and will always take the load, causing a wear of the discus and other articular surfaces but no osseous deformity. Any observing operator will admit that, during mastication, definite forces are at work and that the teeth (no matter what may be their arrangement) are subject to the effect of such forces, but do not control it; also that tooth guidance is not the controlling factor in the movements of the mandible, and that the size and type of the masticating unit, its type of suspension and muscular control will compel all other factors to harmonize in function or suffer consequent changes in tooth positions. I agree with Dr. Washburn that we can have real function only when the teeth are correctly opposed and those contiguous take their correct positions. It is unfortunate that he speaks of ideals and then does not help us to visualize them, or even attempt to establish them. "In this paper there will be no attempt made to solve the question of what constitutes a normal in occlusion, but we do hope to present enough points of view that we may all be induced to greater effort to determine the best type of tooth and jaw relationship." It would be unfortunate for any man to cast all into his standard (?) mold and compel a fit, for we must ever continue to deal with every case as a distinctly individual problem. True there are some points of similarity, but others are peculiarly individual, refusing to submit to standardization. There are not even two leaves alike on the same tree, and we are powerless when we apply the law of averages to the articulation problem. Will we continue to have variations, and with them, deformities as in the past? Will heredity also continue to exert its influence, or will we be able, by methods yet to be developed, to provoke Nature to do what we want done? These and many other questions are ever in our minds, and I am candid to admit that we have made little or no real progress in the face of them. We may rearrange the teeth by orthodontic means and get slight changes in the secondary osseous structure, but no real change in the primary osseous structures. Changes in these will have to be brought about through

study and consideration of the ductless glands. For this reason, I agree with Dr. Washburn that the influences that govern human occlusion are mysteries and seem to defy solution. In short, solution of the problems of establishing balanced occlusion must not be sought in the so-called spherical alinement of the teeth, but through an entirely different avenue of approach. As we now understand matters, we must continue to consider every case a unit with individual requirements, and compensate for the composite factors, if we expect to give the service our patients justly expect and deserve. Let me again direct attention to the need of careful study and consideration of the ductless glands and their developmental influence in our particular field.

George S. Monson, St. Paul, Minn.: Did you ever see an artist take a subject with a curvature of the spine, or a harelip and model him as an ideal for a portrait or a statue for an athlete? If we dentists have no ideal or no conception of what teeth ought to be, what right have we to practice dentistry? We must first have a conception of what constitutes a normal mouth within the reach of every one of us, and we must study it in such a way that it will bring out the facts regarding the greatest mechanism ever developed by the anatomy and physiology. As to injecting prosthetics into the question, that is secondary. Every man has his conception of what artificial dentures are, but when he goes back to Nature, to the ideal, we will have a different conception. He will have something to work to. Nature is the greatest teacher that we have, both in surgery and in dentistry, and we certainly cannot arrive at anything by studying the deformities first; we at least ought to have something to use in comparison. Dr. Washburn makes a plea to the dental profession, not to a group, but to you as dentists, to contribute your bit toward the advancements of the science of the profession that we love, and if we don't do it we are shirking our duty.

O. DeForest Davis, Minneapolis, Minn.: What maintains the teeth in the position in which the orthodontist places them? When do they stay and when do they not?

J. Lowe Young, New York City: Consider the human mouth, with the tongue on the inside of the teeth, and the lips overlying them on the outside, both organs full of muscles which have a tremendous effect in determining the position the teeth will assume when they erupt. They are not the only things to be taken into consideration, however. As long as we are unable to determine definitely all the factors that are responsible for malocclusion, so are we going to be unable to state definitely that the teeth, when placed in what is termed "normal occlusion," will remain there. I cannot believe that Dr. Frahm meant what he said about no one ever having seen a set of deciduous teeth out of balance. If he really meant that, it is the most astounding thing I have ever heard. Every orthodontist of experience has encountered children with only deciduous teeth that were horribly out of balance. In fact, practically every type of malocclusion that is found in the permanent dentition can also be found in the deciduous dentition. Once in a while, some orthodontist claims that if teeth are moved slowly enough and if they are put in correct position, they will always stay there. This is a fallacy. If there is sufficient imbalance of the tongue or lip muscles, or unusual habits, they will not stay, even when properly placed. The longer I practice, the more careful I am not to make definite promises. The etiology of malocclusion is an exceedingly complex question, and we must be exceedingly careful about our promises until we can definitely determine all the factors which enter into such cases.

Dr. Washburn (closing): Dr. Frahm overlooked the essence of my presentation and focused his attention chiefly on nonessentials. For example, he takes me to task for not announcing that we have this problem solved, especially the steps in treatment. Possibly I erred in my appeal for more dentists to work on this problem, but if I did it was because of a profound feeling that the entire dental profession working together should produce some wonderfully important data on the subject we are discussing. In other words, I did not care to pose as one who knows all there is to know about occlusion, which evidently is Dr. Frahm's idea of me when he accuses me of being pedantic. Rather, it is a rare privilege to be invited to present the results of observation and practice of a number of years with the statement that only after you make like observations can we decide definitely on the points that do not at the present time appeal to us all in the same

manner. Dr. Frahm says we do not need standards of measurement in dentistry, giving us the impression that any man's guess is as good as another's as to what jaw and tooth arrangement is correct. He calls our attention to the fact that even the leaves on the trees differ one from another on the same tree, using this as an illustration of how absurd it is in his opinion to consider standards of measurement for human occlusion. I gained from this that he read my paper to mean all jaws must be exactly alike in order to meet the standard. Nothing could be farther from my meaning, for surely we all know that each individual is of a type and has a tooth and jaw arrangement peculiarly his own, and this would still be so if all were balanced. Dr. Frahm says that I failed to give any inkling as to what constitutes balanced or unbalanced occlusion. I have read that part of my paper carefully with his criticism in mind and it seems that the essential points are there if one will read with an unbiased mind. His most surprising statement to my mind is that the teeth and jaws do not take care of any force, direct or indirect, or applied. That statement certainly needs explanation coming from one who has the reputation that Dr. Frahm has. As a matter of fact, a little further along, he states "Any observing operator will admit that definite forces are at work and that the teeth (no matter what may be their arrangement) are subject to the effect of such forces and do not control it." Dr. Frahm does not believe that we should begin our study of occlusion in the embryo, and he then asks the question "Has any man here ever seen an irregular and unbalanced deciduous occlusion?" I have seen a great many unbalanced, deciduous occlusion cases and so have all of you who have in mind a picture of balanced occlusion. He proves his lack of understanding of the ideas presented in the paper by stating that if we have any loss of molars, the condyles always take the load. That is exactly what I am trying to say. In other words, I endeavored to say that loss of supporting occlusion, whether it be parts of teeth or the entire tooth, ushers in the harmful unbalance. And when Dr. Frahm tells us that the condyles and jaws do not become deformed when an unbalanced occlusion throws the stresses of mastication onto the condyles, he is merely stating that he has never examined craniums in which these deformities have occurred. I want to requote, for Dr. Young's benefit, what I read this afternoon, and that is: "These factors or forces must be thoroughly understood if one is to get the full meaning of any particular type of occlusion under observation. Normal functional forces correctly applied during the development years, other factors being equal, should produce a correct occlusal relationship. In the term force or factor is included hereditary influence, biting forces, lip and tongue habits, presence of abnormal tonsils and adenoids, premature loss of teeth, nutritional disturbances and correlated functional disturbances." We have probably from 200 to 300 people between 35 and 70 years of age who are wearing various types of reconstructions, and when good cusps have been placed in mouths of 50 year old patients they are not only tolerating them, but they are enjoying them and are happier than they have been for many years.

THE PROBLEMS OF DENTURE CONSTRUCTION, INCLUDING THE CONDUCT OF PRACTICE*

By H. J. HORNER, D.D.S., Pittsburgh, Pennsylvania

LEARNING to wear artificial dentures is probably the most difficult problem any individual experiences in his life time in the line of dental work, and because it is so difficult, the patient should be informed, to the greatest possible extent, of the limitations and possibilities of artificial denture restorations. He should be told in no uncertain terms what to expect and what not to expect. It is possible to eliminate a great deal of after trouble by having a complete understanding with the patient. Do not be afraid to tell the truth. Better lose the patient in the first place, if telling the truth means that, than to lose the patient later when he begins to find out for himself some of the things you should have told him. Do not promise what you know you cannot deliver.

Many men will make a denture thirty, sixty or ninety days after extensive extractions, when alveolotomy has not been performed, and neglect to tell the patient that mouth tissues are still in a temporary or changing condition, and he is led to believe that he can expect considerable length of service from dentures made in such a short time after extraction.

In many cases, the tissues shrink and the dentures no longer fit, and when the man who made them is asked about it, he is compelled to tell the patient what he should have told him in the first place. If this were not a very common fault, it would not be mentioned; but as so many cases of this description have been observed, it is deemed necessary to call particular attention to it. The dentist should have the courage to tell the patient the facts of the case as they exist, even though the patient decides to wait a little longer before having the dentures made.

The utmost harmony should exist between the denture patient and the dentist, as the making of dentures is so radically different from all other forms of dental work. The patient should be told that in all his former dental experiences his own cooperation was not nearly so necessary for success as it is in denture making.

If a filling was inserted which was not comfortable, a crown put on that was too high, a tooth broken in extracting, or any dental operation performed which caused discomfort, he was compelled to endure the discomfort until he was able to make another visit to the dentist to get relief.

In denture making, the utmost we are able to give patients in scientific dentures, the time, patience, skill, etc., that

*Read before the Section on Full Denture Prosthesis at the Sixty-Seventh Annual Session of the American Dental Association, Louisville, Ky., Sept. 22, 1925.

have been used will be utterly useless without the fullest cooperation of the patient, for the simple reason that, as soon as he leaves our office, he is no longer under our control and he can immediately remove the dentures if they are uncomfortable.

CLASSES OF DENTURE PATIENTS

Denture patients can be divided into two general classes: the inexperienced denture patient and the experienced denture patient.

The Inexperienced Denture Patient.—The patients that are probably the most difficult to handle are those who have never had any form of removable appliance in the mouth. It is only natural that the comparison they make will be between the natural teeth and the artificial teeth.

We realize that one of the most difficult things the patient has to do is to reconcile himself to the fact that his teeth must be lost. His attitude is usually rebellious and he is filled with bitterness. As he has always had the means to pay for the best obtainable dental services and has been in the hands of a dentist in whom he had the utmost faith, he is at a loss to understand why he must lose his teeth. He is displeased with the dentist because he was unable to save his teeth, and again he is dissatisfied with the physician who condemned the teeth. He is almost angry with the exodontist who removed the teeth, and by the time he gets to the prosthodontist or dentist, he does not feel very kindly toward any member of either profession and is frankly skeptical about what we are going to do to make him comfortable and well again.

We face the problem of trying to set a fee sufficient to justify us in giving the best we have to offer and at the same time not build in the patient's mind, an ideal of a perfect denture which cannot be placed in his mouth by the most skilful operator.

The Experienced Denture Patient.—A patient who has worn any form of removable appliances or one who has worn unsatisfactory dentures for some time is easier to handle than the inexperienced patient. He is partially educated to the sensation of the foreign bodies in the mouth, and as he is more or less discouraged, he will not expect too much.

By leading patients to tell what they actually expect in efficiency in artificial denture restorations, it has developed in several recent cases that some patients are expecting from 70 to 95 per cent efficiency as compared with good natural teeth.

GUARANTEES

Materials.—We still occasionally have to contend with results of the "twenty year guarantee" propaganda put out by advertising dentists, and while a guarantee is not often asked for, it is well to be able to have a satisfactory answer ready when the point comes up.

When a guarantee regarding the quality of the materials that enter into denture construction is asked, the attention of the patient is called to the fact that artificial teeth are not actually teeth at all, but a man-made substitute for natural teeth, and the materials used are the same as are used in the manufacture of other articles which are in daily use and for which no one would think of asking a guarantee.

Most patients have about their person,

eye glasses, jewelry, rubber buttons, combs or hair pins made of rubber. Their attention is called to the metal in the eye glasses and to the rubber buttons and then to 5 and 10 cent store porcelain, and then they are told that dentures are made from the same materials and they would not think of asking for a guarantee for any of the articles mentioned. If any of these articles break or wear out they are replaced; so when dentures are constructed from the same material, it is not fair to expect them to last for a life time.

Service.—Sometimes, we are asked to guarantee satisfactory service, efficiency, facial expression, etc.

REPORT OF CASES

In one of the most difficult cases of denture construction that we have ever handled, the day the consultation was held, some pink base plate wax was used to show how the bite could be opened and facial expression improved. The patient stated that she was a minister's widow and was unable to pay a large fee. A fee was agreed on, and an appointment made for the impressions. When she came for the impressions, she was in no hurry to sit down in the dental chair, and finally she said, "Doctor, if you will guarantee to give me the facial expression you showed me the other day, and also guarantee that I will be able to eat with the teeth in a satisfactory manner and that they will be comfortable, I will let you have the case." My immediate reply was that if she offered me a fee of ten times the amount agreed on, I should be compelled to refuse to guarantee the case.

The problem then was to get her to have the proper mental attitude and point of view, and also to make her see how very necessary were her own efforts, and the manner in which she would carry out the part that depended on her in order to have even a reasonably successful result. I then said to her, "I am sure you mean to be fair to me and I am sure you do not fully realize what you have asked me to do. I explained that, in asking for the guarantee, she had asked me to have all the patience and give all the time that would be required for the work, and then she had further asked me to do her part of the work and guarantee to her what she could do with the result of my work after I delivered it to her; that it was just as necessary for her to do her full part as it was for me to do mine before a successful result could be reached. She finally saw the light, and the work was started.

TEMPORARY AND PERMANENT DENTURES

There is no such thing as a permanent denture or a temporary denture, because the tissues in the mouth are constantly shrinking and changing, making the mouth conditions temporary rather than the denture. The denture, because of the material from which it is made, does not change.

The degree of permanency depends entirely on the extent and rapidity of the shrinking process in the mouth, and this shrinking is under the control of neither the patient nor the dentist, but is one of Nature's processes. So it is not well to use the terms temporary and permanent as there is a wide spread belief among patients that a temporary denture can be made quickly and cheaply and that a permanent denture can be made later.

It is always necessary to explain in great detail that, while the mouth conditions do change, the denture remains stationary and cannot change. One question that has to be answered more than any other is, "How long will I be able to wear this denture?" And our usual answer is, "If you will answer two questions I shall be able to answer your question: How much will tissue conditions change in your mouth, and how

much time will be required for the change?"

They cannot answer without just guessing, and we say that if we were to say how long they could wear a denture it would be just guessing. We tell them that in different individuals these changes take place in varying degrees, and they may be able to wear a denture a few days, a few weeks, or months, and perhaps a year or two.

If it were not for three most valuable requisites that every edentulous patient always brings with him, successful dentures would be practically impossible: (1) the need of teeth to make him presentable; (2) the need of masticating his food, and (3) the wonderful toleration of the human tissues to a foreign body.

This has been demonstrated many times by patients having dentures that are retained by absolutely nothing but habit. Cases have been observed in which, when the tongue was removed for an instant, the denture would drop.

Patients sometimes come in, a few days after having dentures made, and are very much discouraged and ask if they will ever learn to use them. This is a good time to explain just what difficulties are to be overcome, and we say that we do not wonder that they are having trouble; in fact, we sometimes wonder how they ever become accustomed to wearing dentures at all.

The mucous membrane lined oral cavity is second in tenderness only to the eye, and the denture is made of a material which does not stretch or give, in any way, yet the patient is able, after a while, to grow accustomed to it.

It is a common occurrence for a patient who is wearing a full denture that has been articulated to natural teeth in the mandible to wish to have a new lower denture made to the old upper. In such cases, a level occlusal plane on the old upper denture is rare, a very uneven and irregular plane being the rule.

The old upper denture having been comfortable and satisfactory, it is difficult for the patient to understand why a satisfactory lower denture cannot be made to articulate with the old upper. In many cases, the upper denture was occluded with only the anterior lower teeth and no attention was paid to the arrangement of the bicuspids and molars. In all such cases, we invariably refuse to make the new lower denture to the old upper and insist on making new dentures, persuading the patient to agree to leave the old denture in our office for a month or six weeks while the new dentures are being adjusted.

Another thing we are often called on to do is to construct an upper denture when one or two upper teeth remain. This we do not consider good practice, and so refuse to do it.

We have made it a rule never to reset a denture that was not made in our office, and when patients present an old denture for resetting, we ask why they wish it reset and say that from the expense standpoint little or nothing can be saved. This matter of resetting old teeth is a relic of the days when we used to charge so much for the best materials in a so-called temporary denture, and then make it all over again, taking a new impression, etc., for about one-third the original fee. This practice has been discontinued, and we usually say that if we are to be responsible for the result of the work, it is better to use all new materials.

The research department of the National Cash Register Company has proved that information conveyed to the brain through the eye is twenty-three times more efficient than the information that is conveyed to the brain through the ear. Advertising authorities have demonstrated that illustrations in color are seven times more efficient than plain black and white. Believing that telling the patient by word of mouth is not sufficient, it is our custom to use as many demonstrating devices as we can find useful, and we find that the number that can be used is constantly increasing.

When immediate denture service is requested and an alveolotomy is indicated, two methods are used to get the message to the patient. The mere description of an alveolotomy usually causes a patient to say "Isn't that a terrible operation?" So the first explanation is as follows: Four casts of edentulous mouths are shown, the first (Fig. 1, above, left) made from an impression that was taken a day or two after the extraction in the ordinary way, of quite a number of teeth. This shows the rough, uneven condition of the untrimmed process. The second cast (Fig. 1, above, right) shows the condition of the same mouth a few weeks later, with absorption and the tissue change not yet completed but showing a marked change from cast number one. The third cast (Fig. 1, below, left) shows the

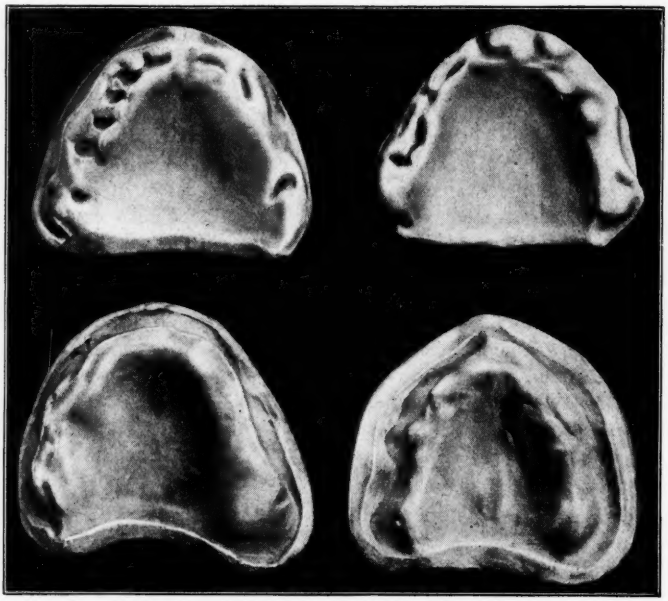

Fig. 1.—Casts showing progressive tissue change.

condition of the same edentulous mouth about one year after the extraction, with tissue change practically completed. Then a fourth cast (Fig. 1, below, right) made from an impression of an edentulous mouth a day after a good alveolotomy had been performed, is shown to the patient, with the explanation that the surgeon, at the time of the extraction, had removed only that part of the process which would have naturally absorbed over a period of months.

The third and fourth casts look

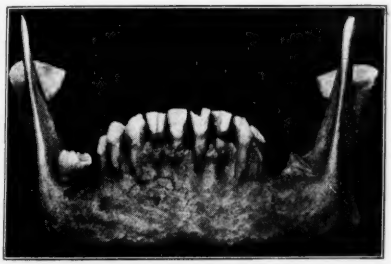

Fig. 2.—Mandible showing bony partitions between the teeth.

somewhat alike, and we tell the patient that instead of waiting many months for Nature to absorb the process, it is better to have it removed at the time of extraction.

The second method of explaining the necessity for an alveolotomy is as follows:

Three mandibles are used, one (Fig. 2) with most of the teeth in place; one (Fig. 3) showing where the teeth have been removed, leaving one side in the rough state that is found in the ordinary extraction and the other side showing the result of an alveolotomy (this side has been smoothed down with a stone after the teeth were removed), and the third (Fig. 4), an edentulous one, showing tissue change practically complete.

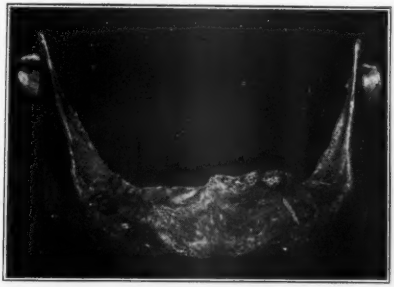

Fig. 3.—Mandible used to illustrate how alveolotomy is performed.

The argument is then presented that if immediate denture service is demanded, the new dentures can certainly be worn on a smooth surface with much greater comfort and efficiency than if an attempt is made to wear

Fig. 4.—Mandible showing absorption practically complete.

them on the rough, uneven surface where the bone edges have not been removed, and the attention of the pa-

tient is called to the better esthetic possibilities where an alveolotomy has been properly performed.

When the foregoing explanations have been made, the patient rarely refuses to have the work done in the proper manner. Care is taken, however, to warn the patient that because an alveolotomy has been performed, he should not expect too much permanency in his denture service.

Rebasing is not always necessary when an alveolotomy has been performed, but in most cases a better final result can be produced if dentures are rebased.

Present day alveolotomy does not go to the extreme that it did at one time, as most operators prefer to be on the safe side and not remove too much process.

Patients who are getting dentures for the first time sometimes say, "Doctor, my own teeth were never white or good to look at, and now that I am to get new ones, I want small, white, even teeth." We have all had this experience, and a great deal of trouble will be avoided if the request is properly met in the following manner. We have two dentures made to fit the same model (Fig. 5), one made as artistically as possible, with teeth of a fair size, color not too white and as natural an arrangement as possible with proper width in cuspid and bicuspid region; the other with very small teeth, shade one, arrangement absolutely even and perfect, and width in cuspid and bicuspid region unusually wide. The palatal portions of the dentures are shown first, one denture in each hand with index finger entirely covering the labial surfaces of the teeth, and the patient is told that these two sets of teeth were made from the same model. Then the teeth are exposed, and the patient is asked which is the most natural looking. Thus far, the first one has always been selected, and the white, even arrangement, which had been asked for, is rejected.

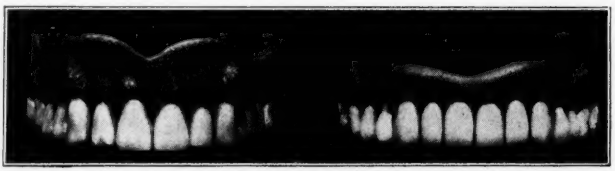

Fig. 5.—Models showing (left) proper and (right) improper arrangement of teeth.

Notwithstanding the fact that we tell all new denture patients that it will take from two weeks to three months to learn to use dentures efficiently, it is not an unusual thing to have a patient come into the office a day or two after the new dentures are delivered to them and say, "I cannot eat with my denture at all, and I am very much discouraged."

This is a good time to explain, in a visual way, the problem of masticating with artificial dentures. For this demonstration, we have an edentulous mandible, a piece of unvulcanized red rubber, and a mandibular denture that approximately fits the edentulous man-

dible. (Fig. 6.) The patient is then told that his ability to masticate food is governed entirely by the number of pounds pressure he is able to exert on the tender, resilient gum tissues, which are placed between hard vulcanized rubber on one side and hard bone on the other, and we show the mandible, rubber and denture, properly assembled in their relative position to each other. Then we explain that his own natural teeth were set directly into the bone, with no tender gum tissue intervening, and, in his former experience, his ability to masticate was governed by the amount of pounds pressure he was able to exert with the muscles of mastication. He is also informed that it has been definitely proved that it is possible to exert only about 10 per cent as much pressure with artificial dentures.

After these demonstrations and explanations have been made, the patient is, in most cases, in a more reasonable frame of mind and not so easily discouraged.

In those cases in which it is not possible to prevent the showing of pink rubber and the patient complains about the rubber that was used in his case, we have six different kinds of pink rubber vulcanized in one piece so that they can be shown all at one time to the patient. He is told that, while none of them are an accurate match in color to his natural gums, the one used was the best that could be obtained and, if he likes any of the others better, we will put it on for him.

All these different methods of demonstrating to the patients, by letting him see as well as hear what we are trying to get to him, are very valuable, a trial of any one or all of them furnishing convincing proof of their value.

COST OF DENTURE SERVICE

Every man should know the value of his services and fix his fees accordingly. Each patient knows his ability to pay and must of necessity be governed thereby.

All dentists have patients who say in substance: "I have heard of your skill

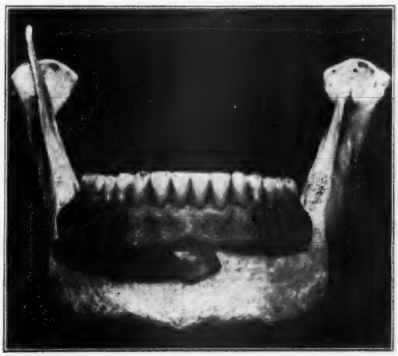

Fig. 6.—Denture, unvulcanized rubber and mandible assembled to show how the resilient gum tissue is compressed between the two hard substances.

in making dentures and I would be very glad to have you make mine, but from what I have heard, I am afraid I will be unable to pay your fee." The reply that is usually made is: "Let me examine your case, and I will quote my usual fee for a case like yours." In case the patient agrees to the terms, nothing further is said; but if he replies, "I am sorry, but I cannot afford to pay that price," the next statement is, "We do not wish to ask you how much money you have, what your income is or what your living expenses are, or any embarrassing questions, but you un-

doubtedly came into this office with your mind made up as to the amount you could afford to pay. How much can you afford?" Sometimes, they reply, "How much will you do the work for?" It then becomes necessary to insist that they specify the amount they are able to pay. The dentures are usually made for the fee named, and we expressly state as a part of the agreement that this is a special fee and not to be quoted. As far as we know, the privilege of special consideration given in these cases has not been abused.

Regarding the cost of dentures to the dentist, this is a subject on which it is very hard to get correct information. Those of you who read Dr. Clapp's reports on cost of dentures[1] will remember that there was a wide range between the lowest and the highest cost. In our office, it is a simple matter to get the average cost of a denture. We simply divide our annual overhead by the total number of dentures made in the year. As nothing but denture work is done, we are able to arrive at an accurate average. The cost has been from $19 to $26 per denture during the past five years. Anyone should be able to determine the cost of dentures in his office by keeping account of the time devoted to denture work, and charging a proportionate amount of the overhead to denture work. Some dentists rate the time of their technician as of the same value as their own, and others calculate this time at a lower rate. That is a personal matter.

The unmeasurable human equation enters into this phase of denture making, and it is doubtful whether a rule will ever be worked out that is elastic enough to apply in all offices.

1. Clapp, G. W.: Dent. Digest.

DIAGNOSIS

The importance of a careful diagnosis should not be neglected or overlooked. Certain deformities and abnormal conditions may not be externally visible, and the patient may not even be aware of them; yet when they are found, the patient's attention should be called to them and a proper explanation of their influence on the success of the case be explained.

When adhesions or ridge prominences are present and the denture foundation can be improved by surgical interference, the patient should be instructed to have an operation performed. In some cases, the patient's physical condition will not permit further operation, and some will be too timid to have such work done. In these cases, if undertaken, the patient should be told that not much success can be expected and they must be willing to abide by the result. I say, if the case is undertaken; for it is certainly not advisable to undertake to render denture service under any and all conditions, and it is better to refuse some cases than to begin work on a case that is almost certain to be a failure. The fact that a failure has been made is likely to be broadcast, but the cause of the failure will not be told. It is better to lose a fee than to have one's reputation suffer.

Many operators find that study models of the case are quite useful and so always take impressions from which study models are made. The study models may be very useful in helping to make a scientific diagnosis of a case; but some skeptical individual once made the remark that "study models in edentulous cases were more valuable in enabling the operator to diagnose the patient's ability to pay than they were

in a physical diagnosis" and there may be some truth in the statement.

In diagnosing a case, it is good practice to try to determine the mental attitude of the patient in its relation to the problem to be solved. Some patients take the matter of losing their teeth very lightly and often remark, "I am going to have these teeth all out and be done with it." This is an excellent time to tell the patient that he may be getting into more trouble than he ever dreamed of. It is not well to allow this type of patient to be too optimistic.

Again, we may find a patient who is fearful, timid and extremely reluctant to face the loss of his natural teeth and the substitution of artificial teeth, even though he knows that it is absolutely necessary that his teeth be removed. In this case, the patient should be told that what others have accomplished, he should be able to accomplish also.

In methods of diagnosis, each operator knows best the case in hand and should be guided by a common sense view as to the best method to solve the particular case in hand.

RECORD TAKING

If dentists in general practice, and exodontists in particular, could but realize how grateful and appreciative patients who find they have to lose all their teeth are, when they are given a chance to have occlusal models made, and facial profiles recorded, there would be no more total extractions, until after the models are made and the profiles recorded.

These patients usually learn sooner or later that records could have been made that would have been a great help in retaining normal facial expression, and they bitterly resent not having been given the chance to have the records made. This record, of course, is taken before extraction, and, as it takes but a few minutes, there is really no excuse for not making it in all cases.

A short time ago, a patient reported that she had visited four dentists before her teeth were extracted, and asked each one of them if they could make a record of any kind, so that when her dentures were made they would resemble her natural teeth, and each had replied in the negative and advised her to have the teeth extracted and then return to him for dentures.

The technic for making an occlusal model, which will show the size of the teeth, the width of the arch and the occlusal relation, is extremely simple and requires but a few minutes. A piece of warm modeling compound is laid over the labial surfaces of the teeth, with the teeth in occlusion, and the patient closes the lips over it, the dentist pressing the lips either with a towel or the hand, for a moment, and then laying some cotton that has been dipped in ice water on the compound. When the compound is hard, the patient is instructed to open the mouth. This releases the lower teeth, and the compound is lifted forward. It is then placed in cold water, and, when thoroughly hard, poured with the plaster. When the plaster has set, the compound is warmed and removed and the occlusal model is complete. The patient's name and the date is placed on the model, and it is filed for future use.

The making of the profile, which has been described by R. R. Gillis, is accomplished by bending a piece of electrician's No. 15 fuse wire so that it will fit the profile from the forehead to a point under the chin, in the median

line; then, laying the fuse wire flat on a piece of cardboard and cutting the cardboard to conform to the pattern made by the wire. When the profile is completed, it can be tried on the patient's face and corrected if it is not right.

This profile cut-out may be used to record the date the profile was made, reference, address, and 'phone number of patient and memos as to whether the occlusal model was made and any individual peculiarities of the case. If any of the incisors are in good condition, they should be saved and the width and length measured with calipers, so that the exact size can be duplicated. It is also well to take the shade of the teeth before extraction, and record it.

Modern denture making can be compared with the former, haphazard hit or miss methods, as: "The elimination of guesswork and the substitution of a definite scientific technic."

This definite scientific technic cannot be completely carried out, as it is possible for it to be, unless the preliminary records are made, and when once the profession realizes how important these records are, every patient will have a square deal.

A New York prosthodontist said recently that he is advocating the making of full occlusal models of young patients, letting the patients have the models to keep for future reference, so that if, in later life, the patient looses his teeth, the prosthodontist will have an accurate guide from which to make natural looking artificial dentures. The prosthodontist is frequently called upon to reproduce a previous condition of which he has no personal knowledge.

By personal questions and observations in a large number of cases, it has been definitely established that the greatest dread and fear patients have is that the facial expression will be changed and that the teeth will look false. Rarely do they fear that they will not have sufficient masticating efficiency.

In view of this fact, it is our positive and absolute duty to give the patient who is to lose his teeth every known service that will make his path less hard to travel; for as all who make dentures know, when the facial expression is good and a natural looking denture is delivered to the patient, the battle is half won. Masticating efficiency comes later. Nearly all patients who were referred to us by former patients come to us because the latter's teeth look so natural.

If any patient has to have all the remaining teeth removed and if enough teeth are present to make a record of any value, I believe it is the absolute duty of the exodontist to send the patient to the dentist who is to make the dentures to have him make the records, and in case the patient has not decided who is to make the dentures, the one who does the extracting should make the records, telling the patient the importance of the records and making a fair charge for the service.

It is not necessary or desirable to follow absolutely every detail given in all cases. The judgment of the patient and of the dentist should determine whatever modification is deemed necessary to get the best results.

DISCUSSION

J. R. Caughron, Oklahoma City, Okla.: Dr. Horner says, "Don't promise that which you cannot deliver." I would say, promise the patient nothing. Tell him you will do the best by him that you can; that the wearing of dentures is based on confidence, and that he must have implicit confidence in the den-

tist or the result will be failure. Study your patient and make sure that he trusts you or do not attempt his case. I have found it necessary to dismiss a few patients before I had progressed far in the making of dentures for them. I have for several years made a practice of making dentures before extracting a patient's teeth. When the teeth are out and before the bleeding has subsided, I place antiseptic ointment in the denture where the open sockets come in contact with it, dash some water on the palate of the denture, dust adhesive powder on it, and place it in the mouth. When caring for a case in this way, I prefer an early morning appointment, and I have the patient return in the afternoon for a dressing of the gums. I repeat the dressing the next morning, with the additional instruction to the patient to remove the teeth several times a day and wash his mouth with a hot saline solution. I also tell him to come to my office any time he suffers discomfort, but warn him that if he removes the dentures, it will be necessary for him again to experience the same discomfort before I can find its cause and remove it. I find it easier to get a satisfactory restoration of the patient's appearance by the use of this method. I do not dread the inexperienced patient as much as the one who has worn dentures for a long time. From the esthetic point of view, I would rather be the first to make dentures for a patient, so that I can get records before his teeth are extracted that will help me in restoring his expression. "Temporary" and "permanent" are terms never used in my office. I always tell my patients that the most nearly permanent denture that I can make is temporary enough. Another thing I always tell the patient is this: If tissue changes in the mouth necessitate a change in the dentures, I can correct the adaptation of the dentures to the ridges, but an additional fee will be charged. Often, I make new dentures in thirty or sixty days, charging for this service. I always try to see that my patients are comfortable, and in this way I hold their confidence. I believe that I can get a much better facial restoration by putting the dentures in the mouth the same hour that the teeth are extracted. This cannot be done after an extensive alveolectomy. While it is true that some of my patients are rebellious about having their teeth out, the percentage is small. The size of the community in which one is located will make some difference as to the amount of trouble one may have in handling patients. My patients are usually "sold" before coming to my office. I am located ten blocks from the business center of the town. Most of my patients are referred to me by former patients and believe in my ability and honesty. Guaranties are seldom asked for by patients who come to me. This happened occasionally when I was located in the business section of the town. I tell patients who bring up this question that a guaranty is not necessary. If I am what I should be, I will do what is right. If he does not believe me to be honest I should prefer that he seek the services of some one in whom he has faith. The success of our work depends on correct diagnosis. When our diagnosis is wrong, our patients usually suffer. In all conversations with our patients, it is best to think much and say little. When a patient comes to me after his teeth have been removed, I ask him if any member of his family has teeth that resemble his natural teeth. If so, I secure records from him that will help me in dealing with the case at hand. The better our records, the greater our success. Our patients are helpless. What we do for them depends on our conception of our moral obligation to our fellow man. Always try to do for your patient what you would like to have done, were you in his place.

C. C. Sparrow, Minneapolis, Minn.: I want particularly to commend Dr. Horner on the stress he has put on the education of the patient before the work is attempted, so that he will know just what and what not to expect. This will eliminate a lot of after-trouble and avoid misunderstandings. Better promise much less than you can actually give, and then you will have a happily surprised patient, instead of a disappointed one. "Do not promise what you know you can not deliver" applies equally well to all branches of dentistry. It is well to inform your patient at this time that the degree of success he will meet with, provided the work has been well done, will depend entirely on his ability to adapt himself to the new condition and the skill with which he learns to use them. Compare your dentures to an artificial limb, citing, for example, how some become so proficient in their use that they are able to get about without detection of the artificiality of the limb. That others are able to dance, play golf and tennis, and almost forget that

they have an artificial substitute. In other words the amount of skill the individual will develop in their use depends on his own efforts. Gain the confidence of your patient by giving him all the information possible on this subject, which, to him, is now all important. You must realize that while the handling of the denture case is to you a matter of daily routine, it is to your patient an event, and that you should do everything possible to ensure a pleasant and satisfactory outcome. Many operators forget that it is another epoch in their life's journey, and to them an all important one. If you will bear this in mind, you will be much more successful in handling your patients and will have more to handle. I cannot agree that the most difficult patients are those who never have worn any form of removable appliances in the mouth before. It is my experience that the most difficult patients to please are those who have worn for years poorly made dentures. When we try to insert new dentures in this patient's mouth, scientifically made, attempting to restore lost facial dimensions, etc., we find, very often, a result that pleases the operator but not the patient. This patient is usually very much disappointed and will often tell you that he is sorry he ever had the new dentures made, mentioning the fee you have asked and comparing it with the fee he paid fifty years ago, and then saying how much more natural the old ones really looked and how much more comfortable they were. This is all very disappointing to the operator, who was probably congratulating himself on the splendid result he had obtained and on how much the patient would really appreciate his efforts, and it places him in rather a bad mental state to meet the situation successfully and skillfully. Dr. Horner has treated the subject of temporary and permanent dentures in a logical and practical manner. The practitioners of dentistry, and not their patients, are responsible for the majority of the unreasonable ideas they have regarding what they are accustomed to call temporary and permanent dentures, and the resultant fees for each. Surely, it is time to get away from these terms. It is, indeed, surprising when one learns the extent to which they are used throughout the country by the general practitioners. Dr. Horner has not stressed the importance of the prosthodontist and the exodontist working together in closer harmony. They should plan these cases together, much as an architect would make his plans for a new structure. Much better results can be obtained in this way, and the work of all be made more satisfactory. This is true with the crown and bridge operator, as well, and the time is not far distant when this will be the usual procedure, instead of the exceptional, as it is now. In citing the three great requisites that every patient brings with him, when in need of dentures, Dr. Horner named as the second one of the classification the great need of masticating his food. I think that he has overestimated the need of mastication, for it is now quite generally agreed among medical men that thorough mastication of food, especially in individuals of middle life or past, is not nearly so important as we once thought. I personally know of an old Civil War veteran who has not had a tooth, either real or artificial, since the war, and has always enjoyed and is still enjoying the best of health. Dr. Horner's method of demonstrating to his patients, by models, the points he wishes to bring out is most commendable and will, in the future, be absolutely necessary in this and all other branches of dentistry. It certainly is ridiculous to think of our trying to sell our services at a good figure when we have not a single thing to show our patients to give them an idea as to just what we expect to accomplish. Place yourself in the patient's position, and just reason how well you would like to part with several hundred dollars for something you could not see or have the slightest conception of. It is one of our very weak points in selling our service. Again, I cannot agree that in some cases we should allow the patient to quote the fee he can afford to pay, and then make the dentures for that fee. In practically every case, the patient will go a little farther and pay a greater fee than that first mentioned. You will also find that this same patient may be able to pay your minimum fee much better than you can afford to make them at his own quotation. If you instruct this patient that your fee should be so much, and that he must tell his friends that he paid this fee, you will find that, ninety-nine times out of a hundred, he cannot get out of your office quickly enough to inform some friend what a bargain he received. The friend will, in turn, tell some other friend who is a prospective patient, and it will not be long before you will find a number coming to you with similar stories simply to get your services at their own

figure. Patients in the habit of doing just this very thing are more often much better fixed financially than the dentist, and always will be until we learn to be more businesslike and more practical in matters financial.

Dr. Horner (closing): Both Dr. Caughron and Dr. Sparrow disagreed with me in regard to the treatment of the inexperienced denture patient. The inexperienced patient has practically no knowledge as to what to expect, and consequently is obliged to accept whatever is offered him. The patient who has had real experience and knowledge in this kind of

Fig. 7.—Face of plastic gum used to illustrate how facial expression can be improved by opening the bite.

work has a standard of comparison. This may not have been a satisfactory one, but it enables the patient to know whether your work is an improvement over what he has had, and if you have any better service to offer him, he will quickly notice the change and improvement. I am very glad that Dr. Sparrow disagreed with my method of handling semi-charity patients, as his point of view will probably call your particular attention to that part of the paper. I have nothing to take back, and I was not offering a theory for the solution of this problem, but was telling you how the problem has been solved in my own practice. I do think that if the dental profession is ever to take its place beside the medical profession, we should show more consideration for the class of patients who are unable to pay our regular fees. We should not conduct our practices in a way that would prevent worthy people from securing our services. A scrap book filled with pictures taken from movie magazines, serves a useful purpose in our educational work. Most of these pictures have been selected because the subjects show their teeth, and it is quite valuable to be able to prove to your patient that many good looking people do not have small, perfectly regular teeth. The pictures also prove conclusively that Dr. Williams' theory of typal forms is correct. When patients sometimes complain of the feeling of bulk which they experience on the insertion of dentures, they are told that the total bulk of teeth and bony process they have lost almost equals the bulk of the dentures. In order to prove this, we have a bottle in which we keep thirty-two extracted teeth. The teeth are held in one hand, and the denture in the other hand, and the patient is told that if we could add to the teeth the bony process which has been removed and has been absorbed, the two bulks would be about equal. The patient is told that when wearing new dentures, their first sensation will be that of bulk. The tissues of the mouth on the insertion of the dentures recognize foreign bodies, and naturally try to expel them. On persistent and continued effort on the part of the patient, these tissues will gradually learn to tolerate them, and, more than that, will reverse their action and help to retain them. The last device I will mention is a small plastic art gum face (Fig. 7), which can usually be secured in the 5 and 10 cent store. This face is compressed so as to represent an exaggerated condition of a closed bite, the pressure is then gradually released, showing an improved facial expression, and a possible improvement of the case in hand by the application of a similar technic, that is, opening the bite. The patient usually sees the funny side of this device at first, but as a rule they immediately grasp the practical side of this and get the idea.

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Editorial

THE CONGRESS

The Seventh International Dental Congress has passed into history, but its results will live in the memory of men long after those most active in its management have departed beyond human ken. No such membership was ever before recorded in a dental congress, and no such attendance was ever approached. On account largely of the unit plan inaugurated by the President, Dr. Logan, the membership mounted to approximately 35,000. The latest data on attendance placed the number somewhere between 14,000 and 15,000.

To record a tithe of the activities of this great event is out of the question, and no attempt will be made at this time to do so; but one of the most inspiring spectacles of the meeting was the formal opening on Monday night at the Academy of Music. It is safe to assert that never before has there been seen such an aggregation of prominent dentists as were gathered to-

gether on that occasion, and no such exercises were ever witnessed since dentistry had a history.

The addresses of Hon. J. Butler Wright, Assistant Secretary of State, of Washington, D. C., and Senator Henrik Shipstead of Minnesota were notable, and emphasized the growing interest in the welfare of dentistry on the part of the Government. The fact that Congress passed a bill, largely through the efforts of the Secretary-General, Dr. Otto U. King, which empowered the President of the United States to extend an official invitation to the governments of the different nations of the world to send delegates to the Seventh International Congress resulted in a larger representative attendance from abroad than could otherwise have been possible. The unfortunate exchange rates in some of the countries were instrumental in keeping many excellent men away, but in the face of all the apparently insurmountable barriers, it may be stated without exaggeration that the cream of the profession the world over was represented at Philadelphia.

In the roll call of nations, there were forty-three responses, and as each of these distinguished men came forward and said a few words on behalf of the profession of his country, there was a conviction on the part of the vast audience which filled the Academy that dental history was being written that night. The roll call of the various states in our own Union, with the numbers represented in each state, made a proud moment for the profession of this country.

The formal addresses by the President of the American Dental Association, Dr. Sheppard W. Foster, and by the President of the Congress, Dr. William H. G. Logan, were dignified and comprehensive, and truly typical of the splendid men presenting them. The former dealt chiefly with the development of organized dentistry, and the latter with the present problems of dental education the world over. Each speaker very graciously extended a cordial welcome to the United States to all the visiting delegates to the Congress.

The Scientific Sections, of which there were fifteen, pre-

sented a mass of material which will add immeasurably to the permanent literature of the profession. In the concentration of ideas rendered necessary by the limit of time placed on each speaker, the essence of every subject was presented in the fewest possible words, and it is safe to assume that there was less verbiage at this meeting than ever before at any similar gathering.

The clinical program on Friday, the last day, was organized under the auspices of the American Dental Association, and its success was beyond all conception. Usually, the last day of a meeting, particularly a meeting of the magnitude of this Congress, is devoid of interest and meager in attendance; but, in the present instance, the exact reverse was true. The large clinic room was crowded all day, and even when 5 o'clock came and the hour of closing was announced, the crowds were so dense and they were so insistent on remaining that they had to be forcibly ejected by the police. Such a spectacle was never before witnessed at a dental meeting, and it was only typical of the sustained interest in all the activities of the Congress.

The social affairs of the meeting passed off most pleasantly. They consisted mainly of the Government banquet and ball given to the delegates from other countries and their families; the reception by the President and Committee on Organization; the Congress banquet, which was conducted under the auspices of the Committee on Local Arrangements; the reception of the President and officers of the American Dental Association; and the various functions arranged for the visiting women, chief among which was the luncheon tendered by the American Dental Association under the direction of Mrs. Sheppard W. Foster, wife of the President, a most delightful event graced by the charm and beauty of the fairest among the wives and daughters of the dentists of the world.

A pleasant feature of the Congress was the tour made after adjournment by the delegates from other lands. They visited in a body the following cities: Washington, Pittsburgh, Chicago, Detroit, Niagara Falls, Rochester, Boston and New York, this giving them a pleasant diversion after the strenuous days of the

meeting. In Chicago, the delegation from abroad was entertained at a banquet given by Dr. Truman W. Brophy and at another given by the Chicago Dental Society. We have no information about the entertainment tendered them in other cities, but doubtless it was up to the best traditions of the various places.

There were so many outstanding things connected with the Congress that it is quite impossible to recount them in chronological order or, in fact, to recount them at all. There has seldom been any event in dental history that drew to its support the unanimous effort of so large a body of men. To the officers of the Congress must go the chief credit for the consummation of this event, and two of these in particular need special mention—the President, Dr. Logan, and the Secretary-General, Dr. King. Both of these men devoted their best energies to the success of the Congress, not only at the time of the meeting but also during the months and years preceding it. The Committee on Local Arrangements had a stupendous task to perform, and they achieved a high order of efficiency. To stage a meeting of this magnitude placed on them a great responsibility and the Congress is indebted to them for the faithful performance of their various duties. To aid in financing the meeting, it was necessary to have an efficient Committee on Commercial Exhibits, and this work was wisely entrusted to Dr. C. W. Hall of Milwaukee, who performed his duties in a most able manner.

To enumerate all of those who labored faithfully for the success of the Congress would be to write a list of most of those who are prominent in the dental world today, and this of course is impracticable.

But one tribute in particular must be paid—a tribute to those noble colleagues who did the United States the honor of making a journey—sometimes under great difficulty—from their distant homes in other lands, that they might lay their meed of dental lore freely at the feet of the profession of this country. We of the United States are under deep obligation to those splendid men and women who graced the occasion by their presence. It is no idle phrase to say that we have learned to love the members

of the profession in foreign climes. They came to us spontaneously and generously and gave their whole-souled support to the success of the Congress. And what a demonstration of goodwill and brotherly love it was. Truly it was typical of the best traditions of our common humanity, when man meets man in unity of purpose, in loyal helpfulness and in abounding charity.

No more shall we hear of national dentistry after this—no more of the provincialism of our profession. From the nethermost depths of the earth wherever dentistry is practiced, our calling must henceforth be known as a unit. And let it be said that this unity of purpose carried out into the affairs of men is the sentiment to regenerate the world. When the policies of the nations of the earth shall be the same as the policies of the professions, we shall see war relegated to the scrap heap of oblivion, and humanity basking in the sunlight of happiness and goodwill.

And if dentistry, perchance, shall have even a modest role in ushering in a better order of things, and if this Congress shall contribute even a meager mite to that long-sought brotherhood of man, those who were most instrumental in carrying it on to a successful issue may well feel that they have contributed in a concrete way to the general betterment of mankind.

THE SEASONS—AUTUMN

"The ravishment is over;" growth has ceased. The ripened grain is cut, and the mellowness of autumn is settling over the land. All Nature is hushed and content—she has produced, and now she is to rest. The subdued and delicious melancholy of the first touch of autumn—the haze of Indian summer with the soft warm days and the cool nights—the drooping of the garden plants and flowers—the sighing of the winds through the trees—the drifting of the clouds, faster and still faster across the grayish sky—all these speak of the advent of autumn. The first real grip of fall is a bit sad, but yet delightful. It drives us to the fields to gather in the crop of roots, the last belated bounty of beneficent Nature, nestling in their snug beds of earth, brought to full

fruition by the cool autumn nights, and ready for the sustenance of man and beast. What though we have cold fingers and sometimes aching backs stooping to throw them into the rumbling wagon—what though the moist soil clings to our boots, and makes it labor to walk—what though at night we come in from the fields wearied with the exertions of the day—what though we face some of the discomforts of life, there is still the glow of health upon our cheeks, and the hearty appetite—almost the ravenous hunger—for our meals, and the sense of comfort and content as we snuggle by the waiting hearth. And at night how we sleep! There is nothing like the lure of the pillow after a day in the autumn air. Pity the man who has never lived in the country, who has never enjoyed the freedom of the fields, who has never put his breast against the great loving breast of Nature; who has never had to work in the open air, who has never slept with the hum of insects and the sighing, soothing lullaby of Nature in his ears. This is life—life in its primitive, purest form—it is real life. Just to "bank the house" in autumn is to predicate of comfort. Just to batten up the chinks is to make one glow within.

And then to go nutting on a crisp October day—the brown and lucious balls falling with a thud upon the ground, and speaking of snug winter nights when they are to be cracked by the open fire place. Nothing like a ramble through the woods and over the slopes on a cool bracing day in fall.

Autumn is the season of snuggling. We begin to gather around the fireside. The days are shorter and the evenings are longer, and we sit by the open hearth at night and tell the stories of the day. We have music—the boistrous, rollicking music of the home, the free and hearty flow of hilarity and harmony.

And then the stimulating tonic of the first frost, when the "nipping eager air" of early morning puts the very breath of life in our whole being, and sends us more briskly to our daily tasks. We tread the earth sprightly, we drink in the elixir of the atmosphere and feel it tingling through our arteries and veins. We lift aloft our heads and gird up our loins for the fray. Nothing

can daunt us in the face of this impelling force of Nature's clarion call.

Out in the woods and among the trees everywhere, we see the marvelous artistry of autumn. The leaves are tinted as never was achieved by the most skilful hand of man. The browns, the yellows, the pinks and the glorious splashes of red—all are there to delight the eye and warm the heart. It is a glorious spectacle to roam over the landscape and see all this wealth of color and of form. It is a picture more wonderful than was ever produced by art, or conceived of in the brain of human kind. It is the supreme achievement in painting and the last word in the harmony of shades and tints. It is one of Nature's finest efforts, and man's greatest compensations for losing the glories of the summer. He who has never seen this wondrous display of autumn has missed something without which life can never be quite complete.

In the fall, the wild fowl migrates to southern climes, and the birds of the garden and the fields leave for warmer homes. The robins and the wrens and the alert meadow larks all give a farewell signal and are gone. The blackbirds gather in large flocks, and go trooping from tree-top to tree-top, chattering as they alight in masses and agitate the higher branches. No matter how large the regiment, they never collide or interfere one with the other. Their instinct is a surer guide than the science of the human aviator.

The wild ducks gather in the rivers and lakes, calling only long enough to get a migratory meal. They sweep down from the far north in vigorous battalions, driven by the icy blasts of approaching winter, and adding a touch of virile life to the erstwhile quiet bays and marshes. What a glorious, happy, care-free life they would have if it were not for the strident gun of the hunter! But year after year they come, undaunted by the incessant bombardment, living their wild, impetuous existence, and adding a touch of romance and excitement to the lives of men.

And the wild geese, those giant heralds of the air that sweep through space, high up from earth, across the evening

sky—who can witness that wondrous wedge, and hear that rhythmic "honk" without a thrill! What a vision of vigorous life are they—what a demonstration of the marvelous instinct of Nature! In myriads they fly, unerring as the throb and beat of time, living their lives in climes congenial, living their lives of love and fear, of struggle and repose, of consternation and content. How like the human race!

And as the last garden bird has gone, the last duck has flown and the last lingering wedge of geese has vanished, we settle down to the somberness of autumn, willing to welcome in the sterner, hardier, more impetuous embrace of approaching winter.

ROOM FOR ALL

When we see, in some communities, certain bitterness developed by the fact that there are two or more organizations of a similar nature in the same city, each one pulling against the other for preferment and possibly for political prestige, we are led to reflect on the unfortunate waste of energy thus expended. To the outsider, there is usually a humorous side to the situation which relieves it of some of its sordidness, and makes it so essentially human. But the humor is confined to the outsider and is seldom shared in by the contestants. They are so deadly in earnest in their mimic warfare that they fail to see any humor in it. And the issues at stake are usually so infinitesimally small that the wonder is that otherwise sane and sensible men can be influenced by them. The fundamental lesson to learn is this, that it is better for all concerned to pull together than to pull apart, and that when all is said and done, there is nothing more certain than the sublime fact that there is room for all.

DEPARTMENT OF DENTAL HEALTH EDUCATION

CAN HUMAN LIFE BE PROLONGED BY DENTAL PROPHYLAXIS?*

By GRACE ROGERS SPALDING, D.D.S., F.A.A.P., Birmingham, Michigan

IN spite of the fact that "the love of life is a universal instinct" and that any suggestions for prolonging our earthly life seem to have a popular appeal, when it comes to a practical application of such measures, humanity as a whole is totally indifferent. A nationally prominent member of the medical profession states that the greatest obstacle met in the campaign for longer life is the widespread indifference thereto; that while life is our most precious possession, it is also the most neglected. William Cowper once wrote:

> Men deal with life, as children with their play,
> Who first misuse, then cast their toys away.

In our consideration of this question, let us understand life to mean, not mere existence as measured in years, but vitality, energy, activity, recalling the epigram "Life is not mere living, but the enjoyment of health," and that it is "not years but deeds that count."

There are many ways of prolonging human life and an endless number of ways of shortening it. By the evidence we are about to submit, we hope to be able to decide whether dental prophylaxis may be considered as belonging to the group of those measures which promote health, thereby lengthening life.

In 1904, Dr. D. D. Smith described the purpose of oral prophylaxis as: 1. The freeing of the oral cavity of conditions of tooth decay * * * 2. The eradication of infection from the oral cavity. 3. Conserving human health. 4. Prolonging human life.

Dr. Fones,[1] defines dental prophylaxis as "that scientific effort, either operative or therapeutic, which tends to prevent diseases of the teeth and their surrounding tissues." Dr. Fones then adds that this includes practically all the operations in dentistry if properly done, but states that "true prevention of disease is, in its broader conception, a matter of education rather than an operative or a therapeutic procedure."

I should like, for this discussion, to define dental prophylaxis as that scientific effort, educational, operative or therapeutic, which tends to prevent diseases of the teeth and periodontium. I place the educational feature of dental prophylaxis first, since that is, in my opinion, of first importance, because of

*Read before the Midwinter Clinic of the Chicago Dental Society, Jan. 27, 1926.

1. Fones, A. C.: Preventive Dentistry, p. 81.

the fact that the extent of its application, as well as its results, are practically unlimited.

Dr. John Harvey Kellogg, who is 73 years of age (the oldest living member of the American Public Health Association), gives practically all of his income to support, in his own words, "not doctoring, not surgery, but education," particularly as it pertains to hygiene and prevention of disease.

The dentist's own time has limitations, and since, as Poor Richard says, "Time is the stuff that life is made of," it is best that we invest time (life) in such a way as to bring the greatest returns in health (life) to our patients; we can therefore use education as a means of broadening our sphere of influence in dentistry.

We are prone to undervalue the possible effect of the patient's efforts in this field of dental prophylaxis, at the same time unconsciously exaggerating our own, when, as a matter of fact, the dentist's efforts are futile without the cooperation of his patient. What the intelligent, well-trained patient can do for the health of his own mouth is of inestimable value. We must needs enlist as many co-workers in dental prophylaxis as is possible in order to extend its benefits. To repair lost tooth structure and to fail to guard against further destruction of tooth structure, to the very limit of our present enlightenment and with all the weapons at our command, educational, operative and therapeutic, is not taking advantage of our opportunities, or making the best use of our time (life) in dentistry.

When we fail to include the educational phase of dental prophylaxis in our practice, we place a definite limitation on our services, which is a positive handicap and which helps to make of dentistry a luxury beyond the reach of the average patient in the average dental practice.

In this connection, an unusual discussion on "Good Dentistry for the Poor"[2] is suggestive and of importance to our profession. The educational part of dental prophylaxis is referred to by Dr. Ottolengui as the Ford of modern dentistry, while the operative part it is said is apt to be the Rolls-Royce.

The educational division is best dealt with as two separate topics: 1. Instruction in mouth hygiene. 2. Instruction in personal hygiene. In reality, of course, the latter includes the former. As Dr. Alfred Owre says: "It is futile to regard an organ or set of organs as an entity pathologically or otherwise. The *body* is the entity. Within it, Nature's forces play and interplay irresistably. We can help or we can hinder, but we cannot at a single spot check the sweep of these forces. *We cannot detach the question, say, of oral health from the question of health as a whole.*"

In order to play an effectual part in this game of prolonging life, it is essential that we, as members of a healing profession, be enthusiastic teachers of hygiene, believing, especially, in our own specific message: mouth hygiene. A thorough understanding of mouth hygiene, together with the mastering of the necessary technic, will enable patients to provide a complete change of environment for their teeth; to remove soft, visible deposits from exposed tooth surfaces; to break up bacterial films on the teeth, tongue and gingivae at frequent intervals; to disturb interproximal

2. Good Dentistry for the Poor; editorials, Dent. Items Int., November and December, 1925.

stasis; to stimulate circulation in the capillaries and periodontium; to proliferate epithelial cells on the surface of the gums, which act as guards against infection and injury of the underlying tissues, and to improve the health tone of the periodontium. There are many earnest dentists whose patients are obtaining these results, some with totally different methods. Any method which produces the above mentioned benefits, without injury to the teeth or their investing tissues, is a good one. We find, however, that *time* is the one constant, invaluable and indispensable factor, in all really effectual methods, yet we are bound to admit that the best of them are but artificial and accessory means for producing oral health.

The second division of our instruction deals with personal hygiene, its object being to stimulate an interest in and obedience to the laws of health which tend to prevent diseases of the degenerative type, such as those associated with circulation, nutrition, elimination and the central nervous system; at the same time also increasing resistance to infectious diseases. When we limit our activities to the treatment of results, without at least attempting to treat the cause, we are on a par with a medical man who, finding his patient anemic, gives him a course of iron injections without inquiring into the conditions that may have produced the anemia, having their correction also in mind. How limited in value is such service, how short lived and how costly! Can we conscientiously ignore fundamentals?

If we would prolong human life, we cannot ignore certain basic health laws, mental and physical, in spite of all the advancement made in modern dental and medical science. Dr. Harvey Wiley, himself an inspiring example, says that if we are to attain longevity, we must work for it, and "the surest way to possess this great blessing is to turn aside from our artificial diet and environment and come back as nearly as we can to Nature." Again, Dr. Owre says: "How are we to get back? We cannot wipe out civilization; but we *can*, I am convinced, prevent it from wiping us out. I have no hesitation in stating that the most necessary step is the return to a more primitive diet." Dr. Thomas B. Hartzell writes: "Our best weapons are cleanliness and proper food." At this point, it is well to remember that diet is but one factor. Digestion, assimilation and elimination are important, as well as the glands of internal secretion, about which we know so little yet which are a part of the mechanism controlling metabolism, the central nervous system, which in large part controls these glands; and finally that force, mental or spiritual, which invigorates the central nervous system. In short we must get back, albeit it step by step, to the ultimate factors in the etiology of disease.

To teach personal hygiene successfully, we must acquire learning in this science. We need to study and practice it until we are enthusiastic advocates of the laws of health of mind and body, associated with diet, nutrition, elimination, exercise, work, recreation, environment, rest, right thinking and other allied subjects. To keep up one's own enthusiasm and that of the patient's, we can read new books on any phase of hygiene, or read old books, or magazines. Establishing a small library of this literature for our patients' use is also a means of enlisting their interest.

There are some who may question our prerogative in teaching the subject

of personal hygiene. But since we see patients more frequently when well than does any other group of the healing professions, and since the permanent success of our efforts in dentistry depends in large measure on the maintenance of health, who can question our right, provided our instruction is intelligent and conservative? The medical man and his aid, the medical nurse, are preoccupied with the sick and dying; hence, we have an opportunity second to none for the personal enlistment of interest in and cooperation with the laws of health. The annual complete physical examination is too prodigal of time and expense for the average patient, and, for the value of its information, too dependent on accuracy of detail on the part of the examining physician. The reports are all too often full of destructive suggestions (often broadcast) to be a measure for universal application. We must evolve an additional method whereby those ills which so frequently shorten life may be averted. Does it not appeal to you that we can best do this through education in appreciation of the value of life and observance of the laws of right living?

We are inclined to think of the relationship existing between the dental and medical profession in terms of disease, specifically focal infection. Could we not perhaps cultivate a most congenial association with the medical man if we met him more often in the fields of hygiene and prophylaxis? In these delightful and constructive fields, "Health, mental and physical" would be our mutual slogan, and we would be met as co-workers; not as criminals responsible for most of the ills of mankind, as often occurs in the realms of disease.

As in the health maintenance of the mouth, so with the health maintenance of the body, in order to achieve the utmost good for the greatest number, we must enlist many co-workers. Those most interested are the individuals themselves whose teeth and health are in question, and who have the potentiality of real helpers in the effort for their own health promotion, when once enlisted.

We shall only briefly take into account the operative division of dental prophylaxis, not that it lacks importance, but because it is impossible to do more, owing to lack of time.

The manifold operative procedures in dental prophylaxis must have as their objective the removal of all irritation, together with its cause, and the restoration of function to the teeth and periodontal tissues.

The irritants that are a menace to the health of the dental organs and supporting tissues may be classified as mechanical, pathologic and chemical. Among those irritants which are mechanical, we may have calcareous deposits; overhanging margins of fillings; badly fitting clasps, bands, crowns, bridges or partial dentures; traumatic occlusion; food impactions, and incorrect use of toothbrush, dental floss or toothpicks. The pathologic irritants are infections of pulp or periodontium; the chemical may be bacterial toxins or fermenting carbohydrate food remnants.

It is manifestly not enough, for the purpose of dental prophylaxis, merely to remove all such irritants. It is of equal importance that we remove the cause and restore function to these dental structures and tissues, whenever practical, by correct dental restorations, and stimulation, both natural and artificial.

The operative technic here demanded is well known and it would appear needless to dwell on it, except, perhaps, to attempt to modify, in a measure, our evaluation of certain technical procedures. For example, we have laid great emphasis on the importance of high polishing of the tooth surfaces, without apparently heeding the fact that the smoothest enamel becomes quickly coated when there is a disturbance of metabolism, having, for example, so simple an etiology as overeating, incorrect eating or poor elimination. Recognition of this fact is fundamental. Let us at least make the effort to understand the causes, other than local, for accumulations on the teeth.

We have learned, at no little expense of time and effort on the part of some of our confréres, that traumatic occlusion is the chief *bête noir* of dental and periodontal health. Some of us have been driven into a state of nervous excitement in our effort to keep pace with the experts in trauma detection and correction, and, in our hurried grinding, have merely shifted the area of trauma from one tooth to another. We need to learn to be discerning as well as conservative, in all the details of dental prophylaxis, else our remedial efforts may become destructive.

Again, in our zeal to restore contacts and contours, and in our enthusiasm over modern restorative dentistry, we remove a 30 or 40 year old malleted gold filling, sans contour, sans contact, but which, nevertheless, may have guarded the tooth against further invasion of dental caries and the pulp against infection. We may be sincere in our efforts, but defective in judgment, or perhaps lacking in skill and experience, or careless of detail in our technic, if, within a year or so, under the new gold inlay, with its beautifully carved cusps, perfect contour and contact restorations, we have a diseased pulp, with its potential trail of focal infection. This may have occurred because we were too radical in our cavity preparation for inlay retention; or failed effectively to protect the pulp against shock or the dentin against infection. Perchance, we neglected to check up on our occlusion with sufficient accuracy, and we had a resultant trauma. Whatever the cause, it would have been better dental prophylaxis to have left the old filling over a healthy pulp. We sometimes need to choose the lesser of two evils. Let us "make haste slowly" and employ the best of judgment and technic in our replacement of old restorations, since the patient, for whose benefit the changes are made, may have his life history unfavorably altered by the operation.

Since we have suggested a slight modification of our enthusiasm about a few of the many important operations in dental prophylaxis, may we now emphasize the need for greater zeal in putting into practice several major and vital principles?

In order to do the greatest good, and avert the most evil, in the operative field of dental prophylaxis, we must bring our greatest force of action to bear on the detection of dental caries and periodontal lesions in their incipiency. Both, with the minimum of effort, are easily controlled at this early stage, yet, in more advanced stages, each may have a most uncertain prognosis as regards the life history of the involved teeth as well as that of the patient. Hippocrates, the "Father of Medicine," living in the fifth century, B. C., recognized the fact that, in his

own words, "Diseases must be combated in their origin."

Because of the technical difficulties, experience and judgment required of the dentist and the possible danger to life and expense involved for the patient in treating successfully the results of advanced dental caries and periodontal lesions, it is impractical, unwise and inexpedient not to check these conditions in the beginning. In order to bestow the greatest blessings on humanity from the angle of dentistry, we must practice prevention in all its aspects, since we are told upon authority that this is the only means by which we can effectively check the inroads made by dental caries and periodontoclasia on the masticating machine of mankind. The radiogram is an invaluable aid for disclosing the presence of dental and periodontal lesions, in their incipiency.

The systematic, periodic treatment of the mouth as outlined and promulgated by the late Dr. D. D. Smith, nearly thirty years ago, remains an important and distinct feature of the operative section of dental prophylaxis. It is worthy of note that little advance in the technic of the treatment has been made since its introduction. Such treatment is ideal, if the operator is well trained, skilful, experienced and fully appreciative of the complete benefits and qualifications embodied in true oral prophylaxis treatment.

Since this treatment is an ideal one, nothing short of a faultless technic, accompanied by a high and genuine esteem for the value of such treatment, is worthy the name.

One important technical procedure in the treatment is the subgingival exploration, which, if skilfully performed, uncovers a wealth of information as regards both the patient's health and his personal care of the mouth. The tone of the soft tissues of the periodontium is noticeably affected by personal care and bodily health. If the tissue tone of the gingivae is good, the subgingival space is practically obliterated, and the operator finds little, if any, excretions or concretions; while if the tissues lack tone, this space is increased in dimensions, and we may find the following as enumerated by Dr. Smith: "Concretions, calcic deposits, semisolids, bacterial plaques, and inspissated secretions and excretions." Whether the cause of these accumulations is local or systemic, their removal is essential to a production of health in the gingival tissues.

A universally approved operative procedure of far-reaching benefit is the sterilization and protection of pits and fissures in erupting bicuspids and molars, particularly until they come into occlusion. This should include all the molars, even the much maligned thirds. The method of protection may be conservative or radical, but, in any case, it must be adequate as a protection, and not interfere with occlusion.

Some good and wise members of our profession say that therapeusis as a prophylactic measure in dentistry is valuable; some equally wise and good ones say it is of questionable value. But before dismissing the subject too abruptly, I cannot resist calling attention to the rather amusing situation that obtains in the digestive tract. The upper portion, or mouth, is the scene of warfare between the dentist and *Bacillus acidophilus*. The dentist wields his weapon of metaphan, iodin, orange wood, and abrasives, determined on the extermination of this bacillus and all

his progeny. Throughout the intestinal tract, the medical man is caring for the refugees, endeavoring to cause their increase and propagation by lactodextrim and the free use of fruits and vegetables. Who is right and who will win? Is it (*Bacillus acidophilus*) our friend or our enemy? If it is a potential enemy in the mouth, would it not be good prophylaxis, by means of correct eating, to produce an environment so inviting throughout the intestinal tract that, of its volition, it would forsake the mouth, the field of danger, for a safer and more congenial habitat?

The use of sodium ricinoleate is recommended by Dr. Hartzell for neutralizing bacterial poisons in the mouth, especially those formed by the streptococcus group.

But do we not concern ourselves overmuch with matters far beyond the pale of our understanding, at the same time neglecting to avail ourselves of powerful aids, close at hand, which are effective weapons for guarding against disease, such as basic laws conducive to health?

Are we not inclined, unconsciously, to oppose prevention, because so large a part of it, such as the treatment of incipient lesions, as well as its educational phase, lacks the intricate technic on which our minds so naturally and easily center? Do we not, too often, gladly shift these responsibilities to other groups with less training perhaps, thereby admitting our lack of regard for this vital work? May we widen our circle of understanding of dental prophylaxis until we can appreciate and respond to all its varied interests! Dental prophylaxis is the most comprehensive subject in dentistry; in fact, it embraces all of dentistry, and is demanding the best thought of the greatest minds in our profession.

Through the following three main divisions of dental prophylaxis, we believe that we can promote the health, not only of the teeth and supporting structures, but of the body as well:

1. The educational division: It is our duty to impart knowledge and enthusiasm on the subject of personal hygiene, which tends to prevent disease of the degenerative type and to raise our innate resistance against infectious diseases; also, specifically, through instruction in mouth hygiene, to promote the health of the teeth and periodontium and through study and unprejudiced investigation extend our vision indefinitely until it is all inclusive of the primary factors in the etiology of disease.

2. The operative division: Focal infection is a recognized and frequent cause of premature deaths, and such foci of infection are often associated with diseases of the teeth or periodontium, and these are known to be preventable, in large measure, by the operative procedure called for in dental prophylaxis.

3. The therapeutic division: We have authority for believing that we can counteract virulent bacterial toxins especially those of the streptococcus group, and, if advisable, discourage the growth of *Bacillus acidophilus* in the mouth by therapeutics of known value.

In our original premise, life was meant to imply not mere existence, as measured in years, but the enjoyment of health. We are convinced that, by means of a comprehensive understanding and application of the truths and principles of dental prophylaxis, dentists can prolong not only existence, but also the enjoyment of health, life.

PREVENTIVE DENTISTRY AND ORAL HYGIENE IN INSTITUTIONAL WORK*

By HAROLD DeW. CROSS, D.M.D., F.A.C.D., Boston, Massachusetts

EVERYONE is accustomed to hear about prevention. This is an era of prevention, and preventive medicine has taken a strong hold on the minds of the public. Consequently, the idea of preventive dentistry is of much interest. It is a catchy phrase, and we like to believe that dentistry as a branch of medicine is partaking with it of all of the benefits that are supposed to accrue from prevention.

I might attempt to describe to you a wonderful condition in which the public is receiving and the dental profession is giving the full benefits of real preventive dentistry, but I would rather say something that will make you do some constructive thinking than merely to say something that might be pleasing to you at the present time, and I shall attempt to present some of these things as they appear to me.

A word on the status of preventive dentistry: It is impossible to prevent something that has already occurred: we cannot prevent appendicitis by operating on the patient afterwards; we cannot prevent the necessity for dental work or dentistry by filling a cavity, however small it may be. To be sure, filling a small cavity prevents a larger one, and filling a large cavity prevents complications with the pulp, and subsequent troubles. Prevention in medicine does not mean curing a disease after it has already come into existence: it means, literally, to prevent the original occurrence of the disease by some means active before the disease appears.

Oral hygiene, I believe, to most people means only cleanliness of the mouth produced by the process usually known as prophylaxis, or by tooth brushing by the patient himself, and refers merely to this condition of cleanliness and such health as may result thereby, but it does not primarily, in this connection, mean health of the mouth or teeth. We are too much accustomed to thinking of hygiene as cleanliness rather than health. Dental hygiene implies healthy teeth, regardless of the means by which they may be brought to this condition of health. To some, this state of health of the teeth has no actual relationship to the act of cleaning or brushing of the teeth; it means healthy teeth produced by a healthy growth and maintenance of these teeth through the proper functioning of all of the organs and the glands of the body—a complete and satisfactory metabolism.

With these definitions in mind, it is possible that orthodox or technical dentistry is, at the present time, about as near to prevention as it ever will be. I do not in any way belittle the advance that has been made in dentistry during the last twenty-five years, and I realize that the technical developments are very remarkable; but considered from a standpoint of producing healthy teeth, dentistry has been a failure. As Dr. Gies has called to our attention, we have been giving a great deal of atten-

*Talk given at the Third International Mouth Hygiene Luncheon of the American Dental Association, Louisville, Ky., Sept. 23, 1925.

tion to the cosmetic and mechanical features of dentistry, but we have almost entirely overlooked that all-important phase, health. We have almost literally saved the teeth at the expense of the patient's health. Ever since dentistry became dentistry, we have been treating teeth just as if they were a foreign body in the mouth rather than one of the organs of the body, developed and maintained in exactly the same way that other organs are developed and maintained.

And yet we think we are practicing preventive dentistry; but the technic of dentistry is not changed any—we are still repairing teeth, putting in fillings, taking out small fillings and making larger fillings, and in every way we are attempting the local cure, even to our efforts at cleaning teeth. This is probably caused by the fact that so many believe that the cause of caries is entirely a local one; but if there were no evidence except that of the failure to control this disease by means of local attention, it ought to be sufficient to make us look to some other cause and to be willing to accept it and to work on it, even though all of the details as to just how it comes about cannot be demonstrated at the present time.

It is not, I believe, very much to our credit as a profession that it was necessary last evening for a layman to tell us how to handle this job of preventive dentistry. He not only told us how to reach the children and as to the great amount of good which could be done in this manner; he actually told us what kind of dental service to give these children. He came before this great organization of the American Dental Association for the express purpose of selling the idea of preventive dentistry to the members, and in spite of the interest with which you listened, and the applause which you gave to his suggestions, I am wondering how many of you will go back and do these things which he told were so necessary.

We have been working on the wrong end of this problem. We are working in the head of the patient, but on the tail of the problem. We have been attempting to do merely reparative or curative work after the diseased condition has been established, rather than making any effort or attempt to forestall the disease which we recognize as caries.

Those who are working on the tuberculosis problem know better than this: they are giving relatively little attention to the established condition, but great attention and effort is placed on those cases in which the condition is just appearing. Prevention of anything is never so spectacular as is the cure, but prevention is many times more satisfactory.

Mr. Sutton said that dentists were to blame for the bad teeth in the United States; and I say "Of course, who else could be to blame but the dentists?" But as a profession do we believe this, and do we realize its importance? It may be that the next lay speaker who comes before a similar organization may speak more plainly than did Mr. Sutton, and we may hear someone suggest that we are perfectly willing to let these bad conditions occur in order to have an opportunity to treat and repair and patch the teeth.

Little need be said in regard to the relation of preventive dentistry and oral hygiene to institutional work as this differs only slightly from a private practice. There may be in institutions a little better ability to carry out certain procedures; it may be possible that there

can be established a better correlation between dental and medical work; early care possibly can be carried out to better advantage. But, in a general way, whatever applies to private practice applies to institutional work, and whatever applies to dentistry applies to both.

This is rather a pessimistic point of view which I have attempted to show you, but I believe that it is good for us to look on that side, occasionally at least. But it is not all so bad as it may appear.

Reparative dentistry is a failure as far as establishing dental hygiene or health is concerned, but we must realize that we are in a transition period. It is true that the old dentistry is failing to accomplish prevention, and the dentistry that will make for prevention in reality is still unknown. Under this condition, we should not despair, but should attempt to meet the situation as best we can, and under these circumstances, one of the things we should consider is the utilization of all features and all factors that may be leading toward an actual prevention of these dental conditions, so that, when the full knowledge of prevention comes to us, we shall be ready to adopt it and accept it without making any too radical change in our policy or in our procedure.

We should educate the public away from the operative technic that we have taught them to depend on so definitely; educate them away from the efficacy of toothpaste per se and other nonproductive procedures. We should give them definite and positive advice in regard to the efficiency of early care of defects and the avoidance of infection of systemic nature. We should tell them that all the dentistry in the world cannot give them good teeth, for the teeth develop with the rest of the body and the health of the teeth is maintained by a good healthy systemic condition. All of this can be done, and we may continue to practice a great many of the features of our present-day dentistry. On the other hand, with this attitude it will be found that a great many of the present-day practices will be discontinued, greatly to the advantage of the patient.

As we see it today, preventive dentistry is probably much more of a medical than a dental problem and our belief or our attitude toward this will not alter the facts of the case one particle. It will be exactly what it is going to be, and if there is to be a change, the change should be with us. We should prepare ourselves to meet this issue and do more for the coming generation of dentists, preparing them better to handle the situation and to be more ready to meet the situation when it develops.

Our dental students should receive a much more thorough education in medicine, and I believe this should be done at the expense of further expanding and elaborating matters pertaining to a more complicated operative technic. We do not need dentists with a little medical knowledge, but we do need real medical dentists who can see something besides the mechanical operation to be performed; something besides the cavity and the particular tooth in which the cavity is situated. The public believes in the present-time operative dentistry as being very efficient for all of their needs; they are even believing, in many instances, that it is really "preventive dentistry." They believe this because we have taught them to believe it, but

we should change our teaching in order to meet the requirements of the newer possibilities in dentistry. They should be taught the advantages of early care and prevention, and I believe it will be greatly to our advantage to do this before matters of information concerning these things appear from some other source than from the dental profession. It is a useless thing for us to sit here and say to ourselves and to each other that we believe in preventive dentistry and we practice preventive dentistry, and not show this belief and this practice by our interest and our work and our contact with our patients.

DIET IN RELATION TO TEETH DEVELOPMENT*

By C. K. JOHNSON, M.D., Burlington, Vermont

THE decay of teeth and its prevention and treatment has been of much interest to the dentist and the human race in general for many years. There has evidently been much variance of opinion as to the cause of decay. The outstanding features of dentistry have been the promotion of mouth cleanliness and the filling of cavities. More recently, there has been much thought along the line of proper development of teeth and the causes operating against this development. My efforts today will be to call your attention to diet as affecting the prenatal and postnatal bony development.

It has recently been said by a member of your profession that most of the sound teeth in the world existed before the toothbrush was invented. The method of filling and cleaning teeth as done in the past has been attacked, it being asserted that we are building a pleasing structure upon a poor foundation. McCollum says that the application of scientific principles of nutrition to the diet of the expectant and nursing mother and the diet of the child are the important factors in the development of good teeth.

As calcification of the first set of teeth begins by the fourth month of intra-uterine life and the first permanent molars show growth during the last third of pregnancy, the importance of this prenatal period cannot be overestimated. The fact that premature infants are markedly susceptible to rickets adds weight to these statements. The calcium is largely deposited in the bones during the latter third of pregnancy, this making it plain why the premature infant develops rickets. Hess thinks that rickets is mainly of postnatal origin but that its incidence and severity may be influenced by attention to the mother's diet. The diet of the expectant mother should be well balanced and should include an ample supply of foods containing calcium and the vitamins: milk, eggs, meat, butter and green vegetables. Friedenwald says that the pregnant woman's diet must contain sufficient vitamins, especially vitamin A, and an abundance of calcium-containing foods.

Stress has been laid on the point that not only must a diet be adequate in all respects but it must also be presented to

*Read at the annual meeting of the Vermont State Dental Society, Burlington, May, 1926.

the body at a time when its life-giving forces can be utilized in the formation of the body. The artificially fed infant must have cow's milk as a basis of its diet, and the amount should be sufficient to meet its needs. It has been determined that a normal infant requires between 1½ to 2 ounces of milk per pound of body weight each twenty-four hours. A deficiency of certain amino-acids is somewhat balanced by giving a diet higher in protein than that received by the breast-fed infant, with other suitable additions to the diet. The deficiency of carbohydrates in cow's milk is usually corrected by the addition of carbohydrates in the form of sugars or starches.

It is interesting to note that the vitamin content of cow's milk is less in winter than in summer, as a result of deficiency in diet when the cows are confined to the barn. This observation attains more importance from the fact that rickets is much more frequently seen in late winter and early spring. It has also been shown that the antiscorbutic vitamin is more abundant in dried summer milk than in milk that is dried in the winter months; also that milk loses this vitamin by aging. Again, a higher temperature over a very short period destroys less vitamin substance than a lower temperature maintained over a longer period.

It is generally held that an excessive amount of sweets in the diet causes fermentation and the formation of acids, resulting in tooth decay. They may also act by lowering the child's resistance to tooth destruction. One often sees a child that has been on a poorly balanced diet with an excess of sugars, the infant being at times overly fat, and pale, with the musculature poorly developed. It is inactive and late in sitting alone, and there is late closure of the fontanel.

The so-called proprietary foods as a rule are relatively high in carbohydrates as compared to the fat and protein content. Again, a milk with a high fat content may cause deficient calcium retention with resulting poor bony development. A food, to be at its best, should be a balanced ration, as the farmer now speaks of a balanced ration, and should be adapted to the needs and digestive capacity of the individual infant.

Dental decay is very prevalent in undernourished children. Wells reports that dental decay is comparatively rare in the Highland Scotch, and he believes that this fact is due to a simple diet of natural foods. With the Lowlanders, dental decay is very marked, as a result, he believes, of a diet of more refined foods. In Egypt, decayed teeth were extremely rare until modern times, the people having developed habits of luxury. Cross states that 96 per cent of the children coming to this country from southern Europe have sound teeth, while the American children show 96 per cent defective teeth.

The dental clinics in the south treat comparatively few negro children. These children are said to eat solid food very early in life, especially vegetables. Mellanby, reporting her studies with puppies, gives the following interpretations: 1. When calcium is diminished in the food and the fat-soluble vitamin content is high, calcification is reduced, especially that of the dentin. 2. Diminishing the calcium as well as the fat-soluble vitamins resulted in the formation of badly formed teeth. 3. Increasing the calcium in the diet and

diminishing the fat-soluble vitamin content resulted in badly formed teeth, although better than when the calcium was decreased. 4. Increasing the cereals when the fat-soluble content was deficient resulted in badly formed teeth and jaws. She concludes that the structure of human teeth may be materially affected by diet.

McCollum says that there is sufficient evidence for one to conclude that the failure to form firm teeth during the developmental period is largely due to faults in diet.

Mellanby, in speaking of the diet of women during pregnancy and lactation, says that its supervision would certainly result in better growth and less rickets and would do something also to improve the structure of the teeth and thereby reduce the appalling amount of caries in the teeth of children.

Washburn and Jones (1916) made extensive experiments in the feeding of baby pigs and later analyzing their bodies and testing the breaking strength of their bones. Their conclusions regarding bone development are interesting: 1. Sweetened condensed milk, although showing an abundance of nutrient energy units, is an undesirable food for the growing young for the reason that its nutrient properties are proportioned so as to produce a weak and dangerously fat body. 2. When sweetened condensed milk is used, the bones are but two-thirds as strong as those produced by normal milk. 3. The bones of animals fed evaporated milk lack to some extent the strength of those of animals fed on normal milk.

The use of cod liver oil in the infant's diet has been shown to assist in the prevention of rickets as well as in its cure. Within a few days after beginning to give the oil, one may detect a depositing of calcium as shown by the roentgen ray.

The utilization of sunlight and the ultraviolet rays gives a similar result. From what has been said, it may be seen that there are quite definite reasons for the present-day methods of feeding infants and children. That bone growth responds to the demands placed on it is well shown by the fact that when a small bone graft is used to replace part of a diseased or broken bone, this graft grows quite rapidly, depending on the stress placed on it. By analogy, one would expect the teeth to develop more normally if they were used in mastication of at least some of the harder foods.

SUMMARY

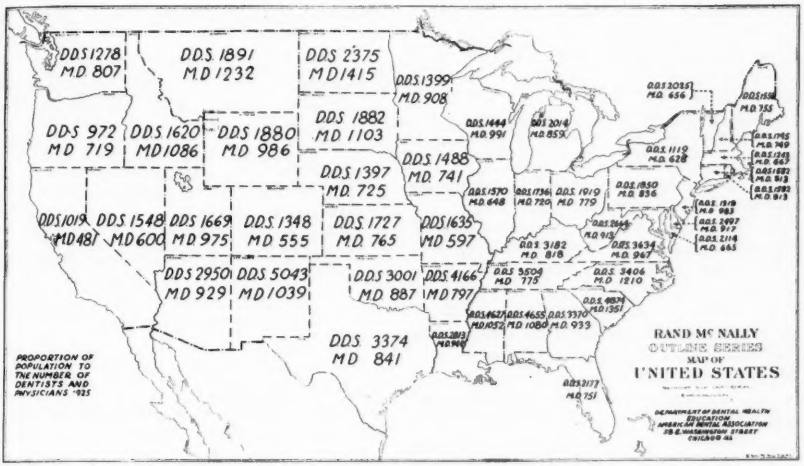
1. The diet and hygiene of the expectant and nursing mother are factors in dental health that should receive more consideration.

2. The artificially fed infant needs a fairly definite amount of fresh, clean cow's milk with suitable carbohydrates added; also cod liver oil and orange juice at 2 or 3 months of age, well-cooked cereals by 6 months, and zwieback or crackers shortly thereafter, with fresh vegetables by 9 or 10 months, and possibly egg yolk.

3. The older child needs a well balanced diet, which should include sufficient food of such nature that thorough mastication is necessary.

4. The ultimate aim is to develop stronger children with better and more lasting teeth.

5. This problem must be attacked through the cooperation of dentists and medical men, and very largely through educational methods.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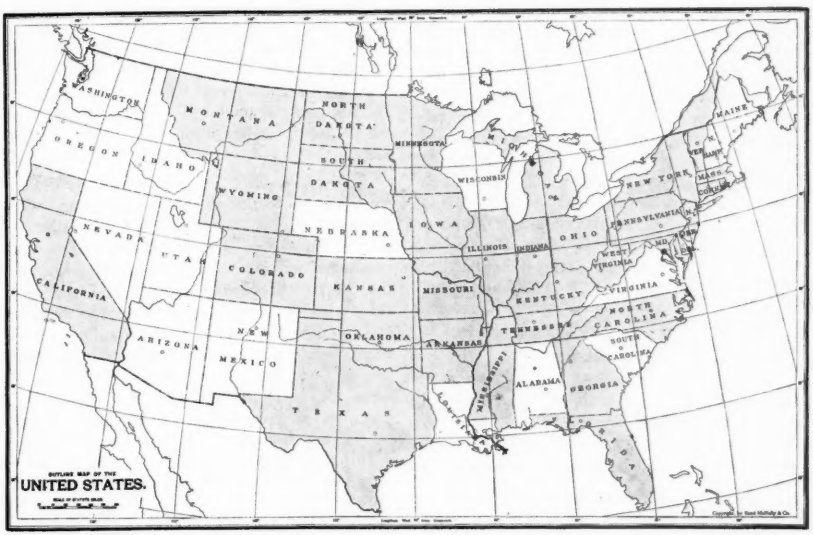
DDS 3001 MD 887
DDS 4166 MD 797
DDS 3374 MD 841
PROPORTION OF POPULATION TO THE NUMBER OF DENTISTS AND PHYSICIANS 1925
RAND Mc NALLY
OUTLINE SERIES
MAP OF
UNITED STATES

Proportion of population to number of dentists and physicians in the United States in 1925.



States (shaded) in which the state dental societies have committees on mouth hygiene and public instruction. Wisconsin has recently appointed a committee.

DUTIES AND CONDUCT OF DENTAL HYGIENISTS IN PUBLIC SCHOOLS*

1. Personal Appearance—Uniform clean and neat at all times. Cap and gown to be worn always when on duty at chair or in classroom.
2. Thorough sterilization of instruments (by steam if possible).
3. The use of any proprietary stain remover is absolutely forbidden.
4. Prophylactic technic taught in dental hygiene course to be followed literally.
5. Give every prophylactic treatment as though for a state board examination.
6. Do not let number of prophylactic cases fall below eight per day—never, however, forgetting quality.
7. Arrange classroom work for regular weekly hygiene period or so as to cause minimum interference with grade teachers program. In other words, cooperate with teachers at all times.
8. Keep the room in which your operating equipment, etc., is set up scrupulously clean.
9. You are under direct control of superintendent or principal of schools and subject to all rules and regulations governing regular teachers.
10. Be prompt and ready for work at the time teachers are supposed to be in their places, working the same hours that they do.

The success of the dental hygiene service in the district in which you are working depends on your enthusiasm, energy and real interest in your profession. Your success will be in direct ratio to the sincerity with which you observe these regulations.

C. J. HOLLISTER, D.D.S.,
Chief Dental Division.
Department of Health.
Harrisburg, Pa.

*A copy of these suggestions was recently sent to every school dental hygienist and the superintendents of all schools in Pennsylvania employing dental hygienists.

NEW LIST OF EDUCATIONAL MATERIAL

A new list of the dental health educational material available from the Department of Dental Health Education has just been published. Copies will be mailed on request to the Department of Dental Health Education, American Dental Association, 58 E. Washington St., Chicago, Ill.

A series of flyers for offices or clinics have just been completed. They are as follows:

To Mothers.
To Boys.
To Girls.
The First Permanent Molar.
Foods and Teeth.
Caring for Teeth.

Prices: To 100, 1c each; more than 100, ½c each.

FIELD NOTES*

The Forsyth Dental Infirmary and the Massachusetts Department of Education, through the University Extension Department, conducted a course in dental hygiene at the Infirmary during the summer. Lectures on the following subjects were given: dental hygiene, dental research, dental health education, diet, relation of state and municipality to dental hygiene, teaching methods as applied to school hygiene and public speaking.

Under the auspices of the Council on Mouth Hygiene and Public Instruction of the Texas State Dental Society, Mr. Willis A. Sutton, superintendent of Schools of Atlanta, Ga., is to tour Texas during October, lecturing on "The Relation of Mouth Hygiene, Health and Education." Mr. Sutton will reach twenty-one communities with his lectures.

Dr. H. L. Freidinger, of Decatur, Ill., has begun work as dental director with the state department of public health under Dr. Isaac D. Rawlings, state commissioner of health. His appointment was the outgrowth of the activities of the state dental society's committee on mouth hygiene and public instruction. Dr. Freidinger will work in close cooperation with this committee, of which Dr. Herbert E. Phillips, of Chicago, is chairman and Dr. Howard S. Layman, of Springfield, sub-chairman. Hereby, Illinois becomes the twelfth state to have a full-time dental worker associated with the state board of health or of education.

*The Department of Dental Health Education will be glad to receive items of news along the lines of education in dental or general health.

Medical and Dental News

GEORGIA

Dr. Marriott Heads State Reserve Officers: Dr. John E. Marriott, of Augusta, was elected president of the Georgia department Reserve Officers' Association at a meeting of the state organization held recently.

ILLINOIS

Dental Hygiene Bureau Established: A dental hygiene bureau was established August 1, with H. L. Freidinger, Decatur, as superintendent. The new department will be supported for one year by the state dental society, the Chicago Dental Society and cooperating organizations with a view to demonstrating its usefulness, in order to induce the legislature to make permanent provision for its support.

Dr. Thomas to Have Charge of Research: Dr. Newton G. Thomas, formerly assistant dean of the University of Illinois College of Dentistry, and in charge of the college research laboratories, is shortly to take charge of the research work of the University of Pittsburgh School of Dentistry.

European Dentists Visit Chicago: More than 200 dentists representing thirty-one foreign countries spent two days in Chicago after attending the Seventh International Dental Congress in Philadelphia. Visits to the three dental schools and a tour of the city were made by the visitors, who were entertained by Dr. Truman W. Brophy, past president of the Fédération Dentaire Internationale, at a banquet on the first day of their stay, and by the Chicago Dental Society on their second evening in Chicago.

IOWA

Iowa State Dental Society Elects Officers: Following are the state dental society officers elected for the ensuing year: president, J. E. Forney, Keokuk; vice-president, E. S. Smith, Iowa City; secretary, John Scholten, Cedar Rapids, and treasurer, Frank Fourt, Fairfield. F. N. Ralston, Des Moines, is president elect.

KENTUCKY

Clinics to Be Statewide: As a result of the achievements in the interest of the public health attained by the free dental clinics and examinations in Owensboro, the state dental association has endorsed an extensive campaign to carry this work to all parts of the state. Owensboro has successfully conducted dental examinations and free dental clinics as a part of its philanthropic undertakings, dentists having given of their time, equipment and materials to improve the condition of the teeth of the indigent children of the community. Dr. R. P. Keene has charge of the statewide program, and will visit all parts of the state.

MASSACHUSETTS

Evening Clinic: A new feature of the Boston Dispensary Evening Dental Clinic is an oral and dental examination given all patients from the health clinic. The dental clinic has five chairs in operation and two or three evenings are devoted to the work each week. Dr. Charles M. Proctor is the chief of the clinic.

NORTH CAROLINA

Midsummer Dental Clinic: The second Midsummer Dental Clinic was held in Asheville, August 16-18. Addresses and clinics were presented by Drs. Sheppard W. Foster, Atlanta, Ga.; C. F. Chandler, Montgomery, Ala.; Edward Kennedy, New York City; Harry B. Johnson, Atlanta, Ga., and J. C. and M. H. Mortonson, of Milwaukee, Wis.

NEW YORK

Orthodontists Elect Officers: At the International Orthodontic Congress, held August 17, at the Hotel Commodore, New York City,

the following were elected as officers of the International Society of Orthodontists: president, Walter H. Ellis, Buffalo, and secretary-treasurer, Charles A. Baker, Evanston, Ill. The present officers will officiate until August, 1927.

Wisconsin

Dental Association Formed: The dentists of Barron, Polk, Burnett and Washburn counties met, August 14, at Cumberland, and formed an intercounty dental association with the following officers: president, W. N. Hedback, Cumberland, and A. W. Thorsness, Spooner, secretary-treasurer.

General

Classification of the Dental Schools of the United States: The Dental Educational Council of America, Aug. 1, 1926, made the following classification of dental schools. Schools are listed in alphabetical sequence by states for convenience only, the order of presentation within each class having no significance. The last previous classification was issued June 1, 1925.

Class A: University of California, Dental Department, San Francisco, Calif.; University of Southern California, College of Dentistry, Los Angeles, Calif.; Atlanta-Southern Dental College, Atlanta, Ga.; Chicago College of Dental Surgery, Dental Department of Loyola University, Chicago, Ill.; Northwestern University Dental School, Chicago, Ill.; University of Illinois, College of Dentistry, Chicago, Ill.; State University of Iowa, College of Dentistry, Iowa City, Iowa; University of Louisville, College of Dentistry, Louisville, Ky.; Loyola University, School of Dentistry, New Orleans, La.; Harvard University Dental School, Boston, Mass.; Tufts College, Dental School, Boston Mass.; University of Michigan, College of Dental Surgery, Ann Arbor, Mich.; University of Minnesota, College of Dentistry, Minneapolis, Minn.; St. Louis University School of Dentistry, St. Louis, Mo.; Washington University School of Dentistry, St. Louis, Mo.; Creighton University, College of Dentistry, Omaha, Nebr.; University of Buffalo, College of Dentistry, Buffalo, N. Y.; Ohio State University, College of Dentistry, Columbus, Ohio; Western Reserve University Dental School, Cleveland, Ohio; North Pacific College of Oregon, Portland, Ore.; Thomas W. Evans Museum and Dental Institute, School of Dentistry, University of Pennsylvania, Philadelphia, Pa.; University of Pittsburgh, School of Dentistry, Pittsburgh, Pa.; University of Tennessee, College of Dentistry, Memphis, Tenn.; Baylor University, College of Dentistry, Dallas, Texas; Medical College of Virginia, School of Dentistry, Richmond, Va., and Marquette University, College of Dentistry, Milwaukee, Wis.

Class B: College of Physicians and Surgeons of San Francisco, San Francisco, Calif.; University of Denver, School of Dentistry, Denver, Colo., (formerly Colorado College of Dental Surgery); Georgetown University Dental Department, Washington, D. C.; Howard University Dental College, Washington, D. C.; Indiana University School of Dentistry, Indianapolis, Ind., (formerly Indiana Dental College); Tulane University of Louisiana, School of Dentistry, New Orleans, La.; Baltimore College of Dental Surgery, Dental School, University of Maryland, Baltimore, Md., (Baltimore College of Dental Surgery was merged with this college, on June 15, 1923); Kansas City-Western Dental College, Kansas City, Mo.; University of Nebraska, College of Dentistry, Lincoln, Nebr.; Columbia University School of Dentistry, New York City, (incorporated with the College of Dental and Oral Surgery of New York, July 1, 1923); New York University, College of Dentistry, New York City, (New York College of Dentistry was merged with this college, June 29, 1925); Temple University Dental School, Philadelphia, Pa., (formerly Philadelphia Dental College), and Meharry Dental College, Nashville, Tenn.

Class C: Cincinnati College of Dental Surgery, Cincinnati, Ohio, and Texas Dental College, Houston, Texas.

Merged recently with universities: Colorado College of Dental Surgery, Denver, Colo., (merged with Denver University, June 15, 1922); Indiana Dental College, Indianapolis, Ind., (merged with Indiana University, June 1, 1925); Baltimore College of Dental Surgery, Baltimore, Md., (merged with the Dental Department of the University of Maryland, June 15, 1923); College of Dental and Oral Surgery of New York, New York City, (United with the School of Dentistry of Columbia University, July 1, 1923), and New York College of Dentistry, New York City, (merged with New York University, June 29, 1925).

Discontinued since the last previous classi-

fication, June 1, 1925: Ohio College of Dental Surgery, Cincinnati, Ohio, (affiliated with the University of Cincinnati, July 1, 1923) Discontinued July 15, 1926, and Vanderbilt University School of Dentistry, Nashville, Tenn., (discontinued, June 21, 1926).

The Dental Educational Council Endorses Conclusions on Dental Education: At a meeting of the Dental Educational Council of America, held in Chicago, June 2 and 3, 1926, the following minutes were adopted:

The Council endorses the general conclusions on dental education in the Twentieth Annual Report of the President of the Carnegie Foundation for the Advancement of Teaching, as presented on pages 77 and 78, and commends them to all concerned as practical solutions of many of the problems which have engaged the attention of dentistry since its inception. Moreover, the Council regards the statements embodied in the general conclusions as a manifestation of a cordial and most sympathetic interest in dentistry as a useful form of health service.

The Council endorses the statement on page 79 in the section on dental education of the Twentieth Annual Report of the President of the Carnegie Foundation for the Advancement of Teaching, which reads as follows: "The most important problem immediately ahead, on this route of progress in professional education, is the radical improvement in universities of inferior dental schools that have been given indifferent attention and which have been conducted, like proprietary schools, as agencies for financial profit.

The general conclusions on the study of dental education, as presented in the Twentieth Annual Report of the President of the Carnegie Foundation for the Advancement of Teaching, 1925; pages 77-78, are as follows:

Dentistry is an important mode of health service that is related directly to the teeth and closely adjacent oral tissues, and indirectly to other parts of the body and to the organism in general.

Dentistry should be made the full equivalent of an oral specialty of the practice of medicine in the quality and efficiency of its service to the patient.

The unusual mechanical and esthetic demands upon dentistry have, however, fully justified and continue to require its active development as a separately organized profession.

The long continued indifference of medicine to the abnormalities and diseases of the teeth and oral tissues suggests that, if dentistry were called stomatology and added to medicine, oral health service would continue to be neglected by the medical profession.

The success with which dentists have brought dentistry to its present state of usefulness and opportunity, in the face of social disparagement and professional belittlement and the strength of the evolution plainly in progress, indicate unmistakably that the leadership of the dental profession will develop dentistry to its full possibilities in health service.

Dentistry can be effectually and economically developed to the full service equivalence of an oral specialty of the practice of medicine, through extension and improvement, in universities, of that system of dental education which, though separate from medical education, is closely related to it and should be more intimately associated with it.

This extension and improvement could be accomplished without requiring the prospective general practitioner of dentistry to become a doctor of medicine before beginning his dental training, and could best be brought about by pursuit of the following three main objectives: (a) the preliminary education and the instruction in the medical sciences should be the same in general scope and quality as for medicine; (b) the technical training, the applications of the medical sciences, and the correlations with clinical medicine should be sufficient to assure both ability to initiate safely a dependable general practice of dentistry and capacity to grow in proficiency; and (c) the most difficult phases of dental practice should be reserved for systematic graduate study.

These three objectives could be attained through the requirement of (a) at least two years of approved work in an accredited academic college, including several courses that would stimulate interest and develop ability in the prospective practice of dentistry, or reveal ineptitude, (b) and three years of intensive and well-integrated effort in an undergraduate dental curriculum for the training of general practitioners only, some or all of the years to be suitably lengthened wherever desirable to meet special local requirements; followed by (c) optional supplementary full-year graduate curricula for

advanced training in all types of dental and oral specialization.

Such a reorganization would place physicians and dentists on the same plane of intellectual quality, and would give them analogous types of health-service education. It would develop similar degrees of medical comprehension, ensure mutual respect and understanding, and facilitate intimate cooperation in the promotion of the welfare of their patients.

This general improvement in dental education would require reconstruction of the dental curriculum, with special reference to important betterment of the teaching in all of its phases, economy of time without impairment of the efficiency of instruction in dental technology, more useful application of the medical sciences, and more advantageous correlation of clinical dentistry with clinical medicine.

The proposed regeneration of dental education would necessitate, in practically all of the dental schools, prompt increase in the number of teachers of the best type, great improvement of the libraries, and active advancement of research.

Lacking endowments, and in most cases being obliged to keep the quality of their work to the level of their income from fees, the dental schools in this country and in Canada will be unable to proceed with the suggested improvements unless, individually, they receive large gifts of funds for this purpose.

Bust of Dr. Talbot to American Medical Association: A marble bust of the late Dr. Eugene S. Talbot was presented to the American Medical Association, June 4, Drs. George van Ingen Brown, of Milwaukee, and Frank Billings, of Chicago, made the presentation speeches, and Dr. Edward B. Heckel, of Pittsburgh, accepted the bust on behalf of the medical association. The original of the bust stands at the entrance of the stomatologic department of the University of Italy in Rome.

Dental Educational Council: Following are the members of the Dental Educational Council: president, Thomas J. Barrett, Worcester, Mass.; vice president, Marcus L. Ward, Ann Arbor, Mich.; secretary-treasurer, Albert L. Midgley, Providence, R. I.; John H. Baldwin, Louisville, Ky.; Henry L. Banzhaf, Milwaukee, Wis.; Frank T. Breene, Iowa City, Iowa; Thomas A. Broadbent, Chicago, Ill.; William T. Chambers, Denver, Colo.; John V. Conzett, Dubuque, Iowa; Sheppard W. Foster, Atlanta, Ga.; H. Edmund Friesell, Pittsburgh, Pa.; William E. Hocking, Devils Lake, N. D.; William H. G. Logan, Chicago, Ill.; Louis Meisburger, Buffalo, N. Y.; George L. Powers, Memphis, Tenn.; Alexander H. Reynolds, Philadelphia, Pa.; Charles R. Turner, Philadelphia, Pa.; C. Victor Vignes, New Orleans, La.

Deaths

Babcock, E. Howard, Brooklyn, N. Y.; New York College of Dentistry, 1889; died, May 27, of pneumonia; aged 63.

Beale, James M., Peekskill, N. Y.; New York College of Dentistry, 1878; died, July 1.

Bond, Joseph A., Warren, Ark.; Vanderbilt University, School of Dentistry, 1886; died of accidental gunshot wound, June 4; aged 73.

Campbell, John, Bloomington, Ill.; died, June 27; aged 93. Dr. Campbell practiced dentistry in Bloomington for more than sixty years, retiring at the age of 80. He was a captain in the Confederate Army in the Civil War.

Davidson, Sidney K., Memphis, Tenn.; Vanderbilt University, School of Dentistry, 1892; was killed in an automobile accident at Hiawatha, Kan., July 14; aged 61.

Eaton, Horace E., Toronto, Canada; Thomas W. Evans Museum and Dental Institute School of Dentistry, University of Pennsylvania, 1898; died, July 23, of heart disease.

Escoitz, Louis E., McKeesport, Pa.; University of Pittsburgh School of Dentistry, 1922; died, June 27; aged 26.

Jones, Corliss H., Chicago, Ill.; Chicago College of Dental Surgery, Dental Department of Loyola University, 1901; died, July 5; aged 59.

Jones, William B., Syracuse, N. Y.; Thomas W. Evans Museum and Dental Institute School of Dentistry, University of Pennsylvania, 1912; died, July 29, aged 62.

Joslin, Walter T., Minneapolis, Minn.; State University of Iowa, College of Dentistry, 1898; died, June 4; aged 51.

LeRoy, Louis Charles, New York College of Dentistry, 1887; died, July 21; aged 82. Dr. LeRoy was a Civil War veteran.

CURRENT LITERATURE

EXTRACTS AND ABSTRACTS

Lead Poisoning Simulating Trigeminal Neuralgia: A case of lead poisoning with onset simulating trigeminal neuralgia is reported by Lee Foshay (*J.A.M.A.*, May 29, 1926). The location of the pain, the patient's description of its character, the homolateral radiation to the arm and the Valleix points of hypersensitivity seemed at first to indicate a diagnosis of tic douloureux of the neuritic type. The entire absence of premonitory symptoms, of vasomotor, secretory and trophic disturbances, and the absence of a tic or other motor phenomena seemed to render such a consideration improbable, but it was not until the characteristic atrophy of the arm appeared that the diagnosis of trigeminal neuralgia finally could be abandoned.

Ivory Exostosis of Mandible Simulating a Tooth: A case of ivory exostosis of the mandible simulating a tooth, in a patient, aged 70, is reported by F. Coleman (*Dent. Surgeon*, June 26, 1926). An enlargement of the lower jaw and pressure of the denture in the cheek sulcus had been noted for several months. In the left molar region, there was a smooth rounded swelling about the size of a walnut. The patient wore complete dentures, with springs. A radiogram revealed a dense mass over the body of the jaw resembling a large and inverted molar tooth, and diagnosed as a dentigerous cyst. On operation, all efforts toward removal were futile. Thereafter, the face wound was dressed frequently and the mouth irrigated. Some fluid escaped at operation and continued to ooze through the wound for several days thereafter. The wound in the mouth healed within a month, and the patient resumed wearing the dentures. An external dressing was still worn. Two weeks later, a loose sequestrum was detected under the skin, and it was planned to remove it within a few days, when it suddenly was exfoliated *in toto*. The external wound healed, leaving a puckered scar. The patient was advised to wear both dentures, but without springs if possible, as these were rubbing against the scar in the cheek and might possibly have been a contributing if not a determining cause of the exostosis.

"Dentistry: Going to the Roots:" The dental profession is so constituted and organized, or rather unorganized, that it is unable to cope with the problem of dental caries in children. The only institution that can meet and solve the problem of dental caries in the school child is the body that the people have created to provide another common need—the prevention of illiteracy. The boards of education must assume, at least for the present, the responsibility of preventing physical degeneration due to a civilization which means living in great industrial centers on unnatural foods in unnatural surroundings, in an atmosphere of smoke; in houses and factories and streets, screened from the life-giving sunshine. We must meet the conditions produced by artificial environment with man-made methods of defense or accept the inevitable alternative—destruction. We cannot combat these conditions with preaching alone. We must practice, demonstrate. True, we must broadcast the truths as we learn them. But let us not give out anything more as a truth until we are sure about it. . . Let us try reasonable experiments, but call them experiments, and in the meantime let us do the obvious thing—take care of existing conditions as best we know and devote much of our wealth of brains and money to research so that we may learn to live, serve and enjoy. . . Thus the dental profession is changing from empiricism to a practice founded on the truths tediously revealed from the storehouse of knowledge. This ever increasing requirement is closing the doors to more and more who might choose to enter the portals of a useful pro-

fession. The decreasing number of recruits constantly increases the cost of service to the public. The public wants high-grade men and the best of service, but most of all it must and will have service. Unless the dental profession can find the means of rendering more service to the people at a price they can afford to pay, the people will find the way themselves, and it will be an obvious way, not one dictated by intelligence, but just a "way out." The people will lower the state requirements, and dentistry would then cease to be a dignified profession and become a technical trade. We must solve the problems that confront our generation. One is to provide some service for the public at a price society can afford to pay. But the greatest and most profound problem before us is that of prevention.—Harris R. C. Wilson, in *Survey*, July 15, 1926.

Eye Signs and Their Significance in General Anesthesia: J. G. Poe emphasizes the significance of eye signs in general anesthesia (*Cur. Res. Anes. & Anal.*, June, 1926) as the means of differentiating the various stages of maintenance, especially in ether anesthesia, which he considers the equal in usefulness of nitrous oxid and ethylene when thus carefully administered. Eye signs are not of such importance to the experienced anesthetist but are immensely valuable to the beginner, enabling him to lead his patient through the various stages with exactness and to avoid toxic stages. The eye signs are classified as lid, globular and pupillary, the lids exhibiting the sensory reflexes and muscular tone; the globes, by their movements and eccentric fixation, show action or tension of the recti muscles; while the pupils show toxicity or freedom from toxicity by their size and reaction to light. Sensory reflexes disappear earlier than normal with premedication, or in the debilitated or the very young. The wide open eye, common in children, may indicate the asphyxial stage in adults. The eccentric position of the eye is common in the intermediate stage, but the axes become parallel, looking straight forward in advanced and toxic stages of narcosis. In the very young, the eyes are usually parallel in all stages. The pupils are normally small during normal anesthesia, dilatation usually indicating toxicity, being due to lack of muscular action. The size of the pupils varies greatly in children from that of adults and without premedication. If dilated pupils are due to toxicity, a few breaths of fresh air will reduce their size; if due to light narcosis, the size is unchanged or augmented. Toxicity is rarely seen in nitrous oxid or ethylene anesthesia apart from asphyxia.

Operation for Cleft Palate: Campbell (*Brit. J. Surg.*, April, 1926) uses a mucoperiosteal flap from the nasal septum to close the gap in the hard palate. It is brought down and sutured onto the raw base left by the elevation of a palatal flap so that the nasal raw surface is in contact with the palatal raw surface. There is no raw surface in the mouth or in the floor of the nose. The cleft is covered by two flaps, one above the other, both of which contain periosteum.—Abstr. *J.A.M.A.*, July 24, 1926.

Focal Sepsis as a Factor in Disease: In concluding a discussion on focal sepsis as a factor in disease, presented at the Royal Society of Medicine, Dr. E. Stolkind (*Dent. Surgeon*, June 19, 1926) says: "There is no pathological, bacteriological or even clinically proved evidence that dental sepsis is the cause of many diseases. Further investigations are necessary to prove this theory. The extraction of all the teeth is always contraindicated and only does harm to the patient: it is an unnecessary experiment. In cases of gingivitis and alveolar pyorrhea, the gums and the teeth should be treated and only teeth beyond repair should be extracted. In some diseases of the head, oral sepsis may be suspected as the probable cause. Then a consultation with the dental surgeon and radiologist should be arranged and the focus dealt with."

Carbon Monoxid Poisoning Following Ethylene Anesthesia: Three cases of carbon monoxid poisoning following ethylene anesthesia are reported by Sherman, Swindler and McEllroy (*J.A.M.A.*, June 5, 1926). In the first, a case of fracture of the leg with possible fracture of the frontal bone and minor injuries, ethylene was administered for fifty minutes, anesthesia being uneventful until the operation was completed and the anesthesia was about to be withdrawn, when the pupils suddenly dilated, the patient became cyanotic and, in spite of artificial respiration with inhalations of carbon dioxid and oxygen, expired. The author believes that a diagnosis of probable fat embolism should be revised in the light of the two similar cases which

followed. In Case 2, an operation for reduction of a fractured malleolus, ethylene induction was stormy, the pulse ranging from 100 to 120. No marked complications were evident until the operation was complete and the anesthetic withdrawn. The period of anesthesia was twenty-five minutes. At its conclusion, the patient did not respond promptly to administration of carbon dioxid and oxygen, being cyanotic and with respiration shallow. After a few minutes, he began to improve. In Case 3, induction was somewhat stormy, but conditions improved and the course of anesthesia promised to proceed uneventfully when, after twenty minutes, the pulse became thready and rose to 135, and respiration became shallow. Resusciation measures were unavailing. A cherry red hue of the skin led to suspicion of a toxic agent in the anesthetic and blood from this patient and from Case 2, in which the same lot of ethylene had been employed one-half hour earlier, showed carbon dioxid present.

Harelip and Cleft Palate: A study based on 400 cases seen in his private practice and in the children's Hospital, Boston, and a review of 262 other operations at this hospital, are reported by W. E. Ladd (*Boston M. & S. J.*, June 3, 1926). The condition is more common among the poorer classes where malnutrition is common. Inheritance seems to play a negligible part, if any. The proportion of males to females was 59:41. Fifty-five per cent occurred on the left, 29 on the right side, and 1.6 per cent were double. There is a variety of opinions as to the best time for operating. The author advocates pushing the maxillary bone in place as early as possible, the lip being repaired at the same time. This, he says, should be done before the sixth month. The palate operation is performed at from 1½ to 2 years. Ether is the anesthetic of choice. Glucose by rectum is given on the operating table as a safeguard against acidosis. Morphin is given the first few days after operation to reduce fretting. Feeding should be by medicine dropper. The stitches are removed in from eight to ten days. Mortality, with the technic given, has been 2.2 in harelip operations. There were no complete failures, but 1 per cent were considered partial failures; in 6 per cent, the results were fair, and 93 were satisfactory. Mortality for cleft palate operations was 3 per cent. In 88 per cent of cases, the results were satisfactory. Speech training should be given careful attention.

Dental Osteitis After Extraction of Teeth: Fourteen cases of dental osteitis following extraction of teeth are reported by Melchior (*Dent. Mag.*, May, 1926). In all cases, extraction had been performed in the area affected, often dating many years back. In nearly all cases, it was ascertained that the extracted teeth had shown signs of chronic periodontitis in the form of pain, tenderness or swelling. In three cases, fractured remainders of roots were found, badly affected with periodontitis. It seems assured that a chronic granular or suppurative inflammation of the root gradually spreads to the surrounding spongy bone tissue, producing a rarefying osteitis in the surrounding area. Disease must then be the primary cause of the bone condition. And since chronic periodontitis is so very common, we must conclude that most of these osseous conditions heal spontaneously on removal of the teeth. In case the bone condition continues to develop after extraction, it must have already reached an advanced stage, or some granulation tissue must have been retained in the jaw, when the tooth was extracted. It is also possible that trauma from the extraction may have exacerbated the condition. Diagnosis depends on the presence, first, of an open alveolus. In several cases, there was pronounced local tenderness. Roentgen-ray examination is important. The condition must be differentiated from cyst, sinus disease or early malignancy. Treatment consists of thorough cleaning out of the osseous focus, with removal of all diseased tissue.

Announcements

CALENDAR OF MEETINGS*

STATE SOCIETIES

District of Columbia, at George Washington University, Washington, D. C., second and fourth Tuesdays in each month from October to June inclusive.

October (1926)

Florida, at Daytona Beach (28-30).
National Capitol, at Washington (5).
Rhode Island, at Providence.

November (1926)

Arizona, at Phoenix.

December (1926)

Nevada, at Reno (4).
Ohio, at Columbus (7).

January (1927)

California, at San Francisco.

February (1927)

Minnesota, at St. Paul (23-25).

March (1927)

Louisiana, at New Orleans.

April (1927)

Alabama, at Montgomery (12-14).
Connecticut, at New London (28-30).
Kansas, at Topeka (18-20).
Kentucky, at Louisville (5-7).
New Jersey, at Newark.

May (1927)

Arkansas, at Hot Springs (9).
Illinois, at Peoria (10-12).
Indiana, at Indianapolis (16-19).
Iowa, at Des Moines (3-5).
Maryland, at Baltimore (2-4).
Massachusetts, at Boston (2-6).
Nebraska, at Omaha (16-19).
New York, at Buffalo (18-20).
South Dakota, at Sioux Falls (9-11).
Tennessee, at Memphis.
Texas, at Austin (10-13).
Vermont, at Burlington.
West Virginia, at Martinsburg (16-18).

June (1927)

Colorado, at Colorado Springs (15-18).
New Mexico, at Roswell.
Wyoming, at Thermopolis.

July (1927)

Porto Rico, at San Juan.
Wisconsin, at Milwaukee (12-14).

Chicago Dental Society, at Chicago, Illinois, January 26-28, 1927.

MEETINGS OF STATE BOARDS OF DENTAL EXAMINERS

Connecticut, at Hartford, November 16-18, 1926. Recorder, A. B. Holmes, Waterbury, Connecticut.

Indiana, at Indianapolis, November 8, 1926. Secretary, J. M. Hale, Mt. Vernon, Indiana.

Kansas, at Wichita, December 6-10, 1926. Secretary, George E. Burket, Kingman, Kansas.

New Jersey, at Trenton, December 6-11, 1926. Secretary, John C. Forsyth, 148 West State Street, Trenton, New Jersey.

North Carolina, at Raleigh, January 10, 1927. Secretary, H. O. Lineberger, Raleigh, North Carolina.

Texas, at Dallas, December 6-9, 1926. Secretary, D. C. Johnson, Atlanta, Texas.

*Announcements must be received by the ninth of the month in order to be published in the forthcoming issue of THE JOURNAL.

CHICAGO DENTAL SOCIETY SIXTY-THIRD ANNUAL MEETING AND CLINIC

JANUARY 26, 27, 28, 1927.—THE DRAKE HOTEL

The Chicago Dental Society announces its sixty-third annual meeting and clinic, at the Drake Hotel, Chicago, January 26-28, 1927. The meeting will as usual be divided into nine sections, as follows:

Section I—Operative Dentistry
Chairman: Robert E. Blackwell, 104 S. Michigan Ave.
Secretary: W. Ira Williams, 122 S. Michigan Ave.

Section II—Full Denture Prosthesis
Chairman: G. M. Hambleton, 29 E. Madison St.
Secretary: John M. Besser, 30 N. Michigan Ave.

Section III—Partial Denture Prosthesis
Chairman: Frank H. Vorhees, 25 E. Washington St.
Secretary: Milo G. Kral, 25 E. Washington St.

Section IV—Oral Surgery, Anesthesia and Diagnosis
Chairman: C. F. B. Stowell, 25 E. Washington St.
Secretary: Joseph G. Wiedder, 25 E. Washington St.

Section V—Orthodontia
Chairman: B. O. Sippy, 30 N. Michigan Ave.
Secretary: J. W. Ford, 25 E. Washington St.

Section VI—Periodontia
Chairman: Edgar D. Coolidge, 25 E. Washington St.
Secretary: G. R. Lundquist, 104 S. Michigan Ave.

Section VII—Mouth Hygiene, Preventive Dentistry, Public Health and Educational Exhibits
Chairman: Herbert E. Phillips, 5457 S. Ashland Ave.
Vice Chairman: E. E. Graham, 58 E. Washington St.
Secretary: Harold S. Smith, 1010 Belmont Ave.

Section VIII—Roentgenology
Chairman: J. H. Prothero, 25 E. Washington St.
Secretary: Frank H. Bernard, 25 E. Washington St.

Section IX—Pathology, Materia Medica and Therapeutics
Chairman: Edward H. Hatton, 31 W. Lake St.
Secretary: J. R. Blayney, 912 Galt Ave.

The slogan for this meeting is "Education." All subjects of vital importance to dentistry today will be covered by the best authorities in the country. Three half days will be devoted to scientific papers and two half days to clinics and lecture clinics. One evening will be given over to a joint meeting with the medical profession and on Thursday noon there will be a special feature luncheon. A banquet will be given on Thursday night, in honor of the visiting state dental society and Canadian province dental society presidents. A preliminary program

will appear in the January issue of the *Chicago Dental Society Bulletin* and other dental publications.

Howard C. Miller has charge of exhibits; Stanley D. Tylman of the clinics; Harris W. McClain, general arrangements; Roy M. Wilson, banquet; Victor H. Fuqua, reception; Frank W. Booth, transportation and Don M. Gallie, Jr., the ladies' entertainments.

HUGO G. FISHER, *Secretary.*

THE UNION COUNTY (N. J.) DENTAL SOCIETY

The Union County Dental Society, a component of the New Jersey State Dental Society, will hold its sixth annual all day midwinter convention, Dec. 1, 1926.

The Auditorium, one of the finest within the state, of the Elks Club, Elizabeth, N. J., with entrance on Union Ave., has been secured. The entire proceedings will be held within the Auditorium. The clinics, starting at 10:30 a. m., will be somewhat of an innovation. Subjects presenting daily problems will be dealt with from the point of view of their fundamentals. This fact should be of intense interest to the general practitioner. The essay of the evening will be given at 8 o'clock, as a courtesy to the out of town dentists. Dinner to our president will be served at 6:30 o'clock. A detailed program will be published later.

Of the 6,800 square feet of floor space, approximately half has been set aside for exhibits, in conformity with our previous practice. Progressive exhibitors are requested to communicate with the director regarding space and other information.

ARTHUR F. WOOLSEY, *Director,*
1162 East Jersey St., Elizabeth, N. J.

INDIANA STATE BOARD OF DENTAL EXAMINERS

The next regular meeting of the Indiana State Board of Dental Examiners will be held at the State House, Indianapolis, beginning promptly at 9 o'clock, Nov. 8, 1926.

Applications must be in the hands of the secretary five days before the meeting.

For application blanks and further information, address,

J. M. HALE, *Sec'y-Treas.,*
Mt. Vernon, Ind.

KANSAS STATE BOARD OF DENTAL EXAMINERS

The Kansas State Board of Dental Examiners will hold their next examination the week beginning Dec. 6, at Wichita.

GEORGE E. BURKET, *Secretary,*
Kingman, Kan.

TEXAS STATE BOARD OF DENTAL EXAMINERS

The next meeting of the Texas State Board of Dental Examiners will be held in Dallas, Dec. 6-9, 1926.

D. C. JOHNSON, *Secretary,*
Atlanta, Texas.

AMERICAN DENTAL TRAP SHOOTERS LEAGUE

The fourth annual shoot of the American Dental Trap Shooters League was held at the Quaker City Gun Club grounds, Monday, August 23, at Philadelphia, Pa., during the Seventh International Dental Congress.

The Lavoris Cup and the 1926 Championship Cup were won by E. L. Knox, Dallas, Texas, with a score of 96 out of 100 targets.

The runner-up cup was won by C. W. Mills, Chillicothe, Ohio, with a score of 92 out of 100 targets.

The next meeting will be held at Detroit, Mich., during the annual session of the American Dental Association in 1927. Various cups and trophies have already been secured.

T. L. PEPPERLING, *President,*
St. Louis, Mo.
C. W. MILLS, *Secretary,*
Chillicothe, Ohio.

BOOKS RECEIVED

Four Lectures on "General Anesthesia." Delivered under the Auspices of and Pub-

lished by the Dental Board of the United Kingdom, 44, Hallam Street, London, W. I. Price, 5 shillings net.

These lectures were delivered in 1925-1926 at the Royal Society of Medicine, the University of Manchester and the University of Edinburgh.

The Dental Assistant. By Emma J. McCaw, R. N., St. Petersburg, Fla. St. Louis, The C. V. Mosby Company, 1926. 119 pages; illustrated. Price, $1.50.

According to the preface of this book, probably the first to be written on the subject, the author has endeavored to make useful suggestions not only to the assistant but also to the dentist who undertakes her training.

Gould's Medical Dictionary. Containing all the Words and Phrases Generally Used in Medicine and the Allied Sciences, with Their Proper Pronounciation, Derivation and Definition. By George M. Gould, A.M., M.D.; edited by R. J. E. Scott, M.A., B.C.L., M.D.; based on recent medical literature. Philadelphia, P. Blakiston's Son & Co. 1398 pages; price, $9.00.

This comprehensive book, by "the Johnson of medical lexicography," is well adapted to the needs of student, practitioner and scholar. It has been the aim of the author to make the work concisely serviceable and practical.

Index of Periodical Literature. Published in the English Language. Including Fifty-Three Publications in England, Canada and the United States, for Five Years, 1886-1890. A Classified Subject Index on the Plan of the Dewey Decimal Classification; An Alphabetical Author Index; A List of Dental Books, Reviewed During the Same Period. Compiled by Arthur D. Black, A.M., M.D., D.D.S., Sc.D., Dean, Northwestern University Dental School. Published by the Dental Index Bureau, 381 Linwood Ave., Buffalo, N. Y., and Henry Kimpton, 263 High Holborn, London, England. Under the auspices of the American Association of Dental Colleges, the American Dental Association, British Dental Association, Canadian Dental Association, New Zealand Dental Association and Society of Dental Science of New South Wales; 1926.

Die Fortschritte der Zahnheilkunde; nebst Literatur archiv. Ein Lehr- und Nachschlagebuch für die Praxis. By Dr. Julius Misch. Leipsic, Georg Thieme; 1926.

Paradentitis Marginalis (Histopathologie, Atiologic, Klinik, Therapie and Prophylaxe). By Dr. Karl Haupl. Oslo, Fabritius & Onner, 1926. 320 pages; 67 illustrations.

Unter suchungen uber Massverhaltnisse des Oberkiefers mit spezieller Berucksichtigung der Lagebeziehungen zwischen den Zahnwurzeln und der Kieferhohle. By Per von Bonsdorff. Helsingfors, Finland, 1925.

PATENTS OF INTEREST TO DENTISTS

1482530. Dentimeter, R. H. Taylor, Meeker, Colo.

1483158. Tooth-cleaning instrument, Edward L. Chott, Chicago, Ill.

1983781. Mounting for false teeth, Arthur H. Churchill, Yarmouth, Canada.

1483217. Analgesic compound and producing the same, Wm. H. Engels, Rahway, N. J.

1483476. Toothbrush, Fred J. Parker, Yorkton, Canada.

1483479. Artificial tooth, Benvenuto Platschick, Paris, France.

1483620. Means for administering an anaesthetic, Charles Spinola, Vancouver, Canada.

1484388. Device for reshaping crown caps, F. W. Doering, St. Louis, Mo.

1484415. Tooth-paste, John P. Shepherd, Chicago, Ill.

1484344. Upper dental plate, Wm. M. Stanbrough, Newburgh, N. Y.

1484663. X-ray filter, Arthur Mutscheller, New York, N. Y.

1485057. Artificial tooth, Lake H. Sprinkle, Brooklyn, N. Y.

1485058. Artificial tooth, Lake H. Sprinkle, Brooklyn, N. Y.

1484800. Dental appliance, Jacob J. Stark, Brooklyn, N. Y.

1485306. Dental bridgework, Jacob J. Stark, Brooklyn, N. Y.

1485963. Protector for dental handpieces, Ward E. Curry, Bradentown, Fla.

1485850. Sanitary toothbrush holder, George J. Hollander, Portland, Maine.

1485778. Cap-crown support, C. J. Holzenthaler, New York, N. Y.

Copies of foregoing patents may be obtained for twenty-five cents each, by addressing John A. Saul, Solicitor of Patents, 509 Seventh St., N.W., Washington, D. C.

THE DAYS THAT ARE DREAR AND COLD

By Ernest V. Madison

Soon it will be winter.

Already Nature's telegraph system is notifying us that this biting, blustering season is traveling our way. Green is changing to brown. Leaves flutter down and skip along with each breeze.

Soon the winds will hold their pow-pows near Medicine Hat, declaring war on out-of-doors comfort, and sending their icy blasts over the border—hurling their white garbed army on roof and stoop and walk.

Then come the days when the cozy interior, favorite chair and comfortable warmth of heating apparatus will replace the golf course, garden, home team, fishing tackle and motor tour.

Then come the days when you have ample time to read—when you can catch up with that pile of periodicals that may have accumulated while you were away on convention and vacation trips, or were worshiping the great out-of-doors.

If there are any copies of THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION in that pile—select them for first reading. The summer issues were among the best of the year.

And get acquainted with the advertisers in those issues by grasping their printed handshakes in the advertising sections. Remember that when you know the advertised products in your field, you know the pure cream.